AN OGDEN PUBLICATION DEVOTED TO GLASS TECHNOLOGY, ENGINEERING, MATERIALS AND GLASS FACTORY EQUIPMENT AND OPERATION

the glass industry

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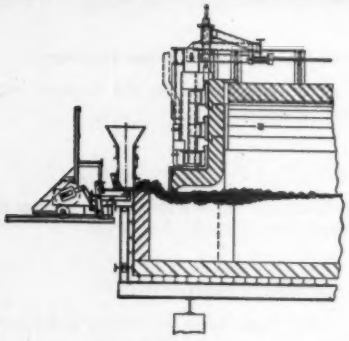

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THE GLASS INDUSTRY

VOLUME 35, NUMBER 2, FEBRUARY, 1954

GLASS CONSIDERED AS A POLYMER

By J. M. STEVELS

Philips Research Laboratories, N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands

PART I

Summary

Certain properties of silicate glass are independent of the nature of the network-modifying ions. They depend principally on the average number of the bridging oxygen ions per SiO_4 tetrahedron, Y, also representing the average number of contact points per SiO_4 tetrahedron. Y therefore constitutes a direct measure of the degree of the polymerization of the network, the latter becoming increasingly loose as Y decreases.

A number of the physical properties of glass are largely determined by the degree of polymerization of the network. When Y lies between 4 and 3, the glass is strong; with values Y between 3 and 2, it is less resistant; when Y is equal to 2, the network consists of chains of infinite length, which are "linked" by network-modifying ions; hence, a network which is both very weak and extremely sensitive to thermal and mechanical influences. When Y is less than 2, the chains are no longer of infinite length—the length is limited. Under these conditions, the chains of the silicates, which are highly symmetrical, crystallize despite their length. On the other hand, the phosphates, because of their lack of symmetry, continue to form the vitreous state until Y is equal to 1, 6. In the case of silicates, however, a small disturbance in the symmetry of the chain is sufficient to counteract crystallization. A number of analogous facts are to be encountered in the chemistry of organic polymers.

The study of the dielectric losses in glass submitted to a medium frequency electric field at low temperatures reveals deformation losses in the network. These losses—which are determined to temperatures as low as 20°K—arise from the fact that certain portions of the chains of the network are able to move on suddenly to another position.

When Y decreases, these deformation losses in the network increase and, when studied as a function of the temperature, reach their maximum at ever increasing temperatures.

Introduction

In the last few years, numerous publications on the physical and chemical properties of glass as correlation to its structure have made their appearance. The first pronouncement in this field was the article by Zachariasen[1] which has, so to speak, become a classic. In it he formulates a hypothesis on the structure of silicate glass, a hypothesis which was confirmed a few years later by the X-ray work of Warren and his collaborators.

Figure 1 is the known two-dimensional representation of the network of a glass. This network is in fact three-dimensional, being composed of Si^{4+} and O^{2-} ions which cohere in space. It contains a large number of interstices in which are to be found numerous ions (the network-modifying ions), such that the whole is electrically neutral.

Generally speaking, the properties of glass are determined by the behavior of the network, by that of the network-modifying ions and by the interaction between these two. It is a fact that many of the properties of glass (e.g., its color, electrical properties, etc.) are directly determined by the second and third group of causes.

A certain number of phenomena are, however, to a great extent independent of the nature of the network-modifying ions, and it is precisely these phenomena to which we wish to draw attention in this paper.

A better understanding of these phenomena would obviously imply considerable progress in the study of the properties of glass. The influence of the positive ions would then be only a question of correcting details. We shall consider in particular those properties that are correlated to the fact that this network behaves like an immense macromolecule, similar to those described in polymer chemistry. This will be some extent justify the title of this paper.

We shall limit our considerations to two points of view. At the moment much is known about the network of borate glasses, but much less about the great variety of unconventional glasses, upon which present-day research is now being more and more concentrated; namely, glass containing fluorine, vitreous nitrates, carbonates and sulphates, tellurite glasses, aluminates of calcium, etc. However, in this paper we shall confine ourselves to the

This article presents the main points of an address given on March 17, 1953 on the occasion of the inauguration of the Conference Room at the Research Centre of the S.A. Saint-Gobain, Chauny & Cirey, 52, Boulevard de la Villette, Paris. It is a translation of the French text published in *Verres et Réfractaires* 7, pp. 91-104 (1953).

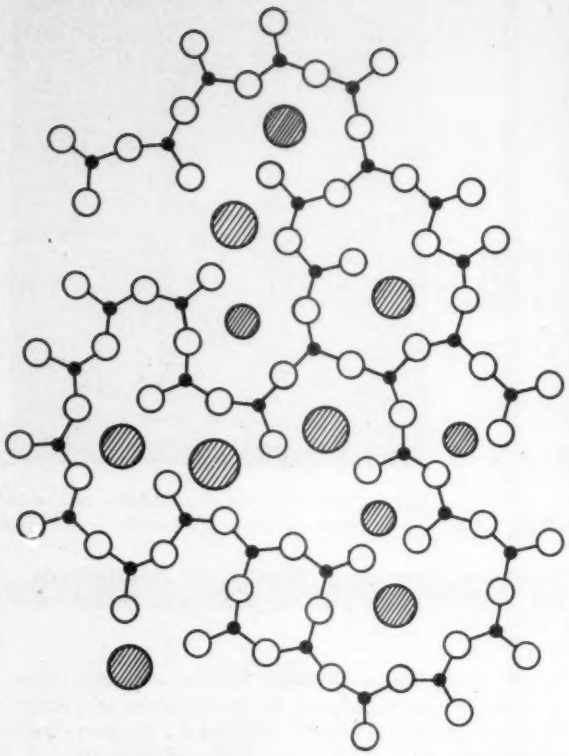


Fig. 1. Two-dimensional representation of the structure of glass, according to Zachariasen. The network so formed consists of network-forming ions, bridging and non-bridging oxygen ions, and network-modifying ions.

classical silicate (and phosphate) glasses, which in spite of everything are still so highly valued by the glass-maker. These glasses, moreover, furnish us with sufficient material to examine a number of questions regarding principles.

Our second limitation consists in the fact that, for a large part of this article, we shall concern ourselves with the (theoretical) case of a glass that is fully stabilized by careful annealing.

Finally, in the last section we shall examine the experiences recently gained with the aid of electromagnetic wavers at very low temperatures, thus enabling us to study the actual oscillations of the network itself.

I. The Chemical Polymerization of the Network

When considering a series of silicate glasses which have been subjected to careful annealing, it is at once possible to calculate from the composition the value of R; that is, the ratio of the number of oxygen ions to the number of network-forming ions. To give some examples, for fused silica SiO_2, $R = 2$; for glass of the composition $NaO.2SiO_2$, $R = 2,5$; for glass of the composition $Na_2O.SiO_2$, $R = 3$; and so on. Needless to say, with higher concentrations of Na_2O the number of O^{2-} ions to be accommodated by the Si^{4+} ions increases and thus the number of non-bridging oxygen ions also increases. The network therefore presents less and less spatial coherence, which may be termed a chemical depolymerization. If we denote by X the average number of non-bridging oxygen ions per tetrahedron, and by Y the average number of bridging oxygen ions per tetrahedron, or the average number of points of contact per tetrahedron, it is immediately clear that:

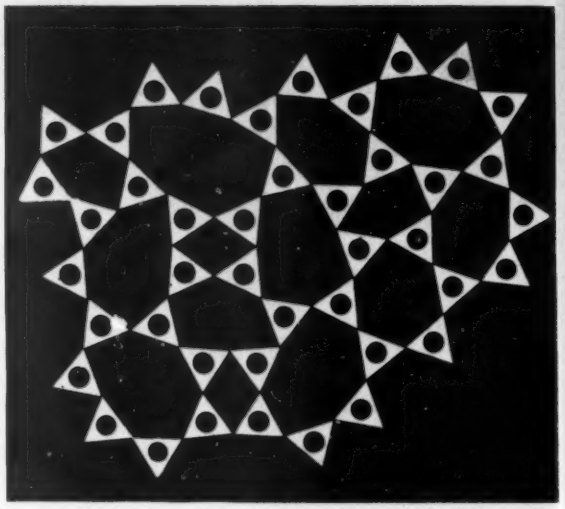


Fig. 2. Constitution of a cohering layer of tetrahedrons in a glass where Y = 3. Each tetrahedron is represented by a triangle, which means that the fourth solid angle is imagined as being outside the plane of the drawing. As in Figs. 4, 5 and 6, the junction tetrahedrons are indicated by a black dot.

$$X + Y = 4$$
$$X + \tfrac{1}{2}Y = R,$$

from which:

$$X = 2R - 4 \quad \ldots\ldots\ldots\ldots (1)$$
$$Y = 8 - 2R \quad \ldots\ldots\ldots\ldots (2)$$

It should be noted that, per Si^{4+} ion, the true numbers of non-bridging and bridging oxygen ions are X and $\tfrac{1}{2}Y$ respectively.[3]

The number of points of contact per tetrahedron, Y, accordingly decreases as R increases. It is obvious that Y is a direct measure of the polymerization of the network, and, therefore, in the following we shall argue only in terms of Y. The relationship between Y and the chemical composition is given by the equation (2). In the case of the fused silica (as long as it is fully stabilized) we have a network of SiO_4-tetrahedrons which cohere to the environment by 4 points of contact ($Y = 4$). The spatial cohesion is at its maximum, and the entire network more or less forms one large polymerized molecule.

On the addition of metallic oxides, this macromolecule is partly "depolymerized" and Y becomes less than 4. As long as Y lies between 4 and 3, each tetrahedron will have 3 or 4 directions, according to which it coheres with its environment. It goes without saying that the degree of cohesion decreases with Y.

It is interesting to note that the volume V of a glass containing an atom gramme of oxygen is a quantity which, with certain restrictions, is practically independent of the nature and of the number of the network-modifying ions. V is (exclusive of a quantity x which depends on the nature of the network-forming ions) a function of Y only in the sense that this volume increases as Y decreases:

$$V = \frac{Vo}{1 - Rx} \quad \ldots\ldots\ldots\ldots (3)$$

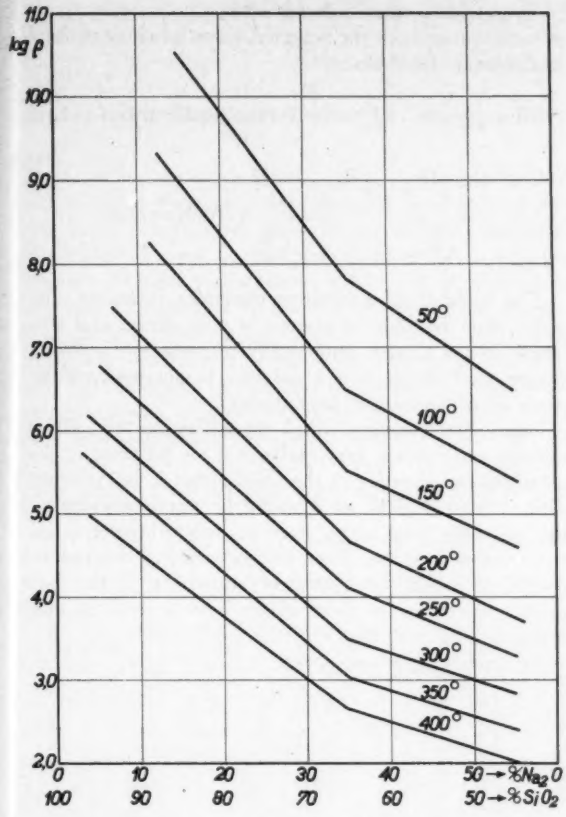


Fig. 3. Variation of the logarithm of the specific resistivity of sodium silicate glass as a function of the composition, vide E. Seddon, E. J. Tippett and W. E. S. Turner, *J. Soc. Glass. Techn.*, 16, 450 (1932). In the case of Y = 3, the curves exhibit a sharp bend, the location of which is independent of the temperature.

where Vo is constant, whereas the relationship between R and Y is linear (eq. 2). V is therefore an example of a property which depends practically solely upon the network itself.[14]

Generally speaking, the networks become less coherent as Y decreases. This is proved by the variations in a large number of physical properties, such as the coefficient of dilatation, viscosity, etc. When Y finally becomes equal to three, there are on an average three points of contact to each tetrahedron. One could, of course, imagine that a small number of tetrahedrons would still cohere to their environment by four bonds, and some by two only, but this number will be sufficiently small to be disregarded.

The network is in this case made up of a certain number of non-planar layers, one of which is depicted in Fig. 2. To avoid misunderstanding, it should be noted, however, that these layers may be twisted one around the other or even intertwined. Cohesion is assured, moreover, by the modifying ions in the interstices in between. The value Y = 3 is a noteworthy value. When Y drops below 3, a certain number of tetrahedrons is produced which will have only two points of contact. This results in an additional weakness in the spatial cohesion of the network, as revealed in the form of a sharp bend in the characteristic representing the variation of the specific electral resistivity as a function of the concentration (Fig. 3). Moreover, formula (3) is not applicable to values of Y less than 3.[14]

The cohesion of the network decreases very rapidly in the range of values of Y between 3 and 2. When Y is 2.5, the network possesses a similar number of tetrahedrons having two points of contact as those having three. The latter, the so-called junction tetrahedrons in the network, are therefore normally connected to one another by means of one tetrahedron having two points of contact. The chain between the nodes (including the ends) therefore includes three tetrahedrons. Taking the case of Y = 2⅓, there are normally speaking two tetrahedrons, each with two points of contact between two junction tetrahedrons. The chain then usually includes four tetrahedrons (Fig. 5). Generally speaking, it may be said that chains of (on the average) p tetrahedrons are found for a value of

$$Y = \frac{2p - 1}{p - 1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The marked analogy between "silicate" and "phosphate" networks arises from the fact that the physical

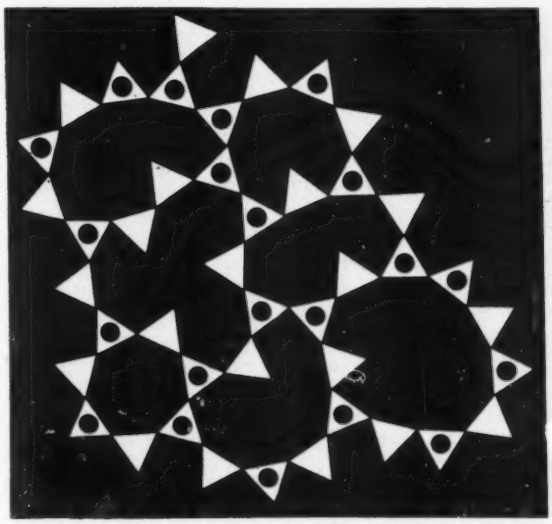


Fig. 4. Constitution of a coherent tetrahedron layer in a glass when Y = 2.5. The tetrahedrons with only two points of contact have no black dot. The "length of the chain" usually averages 3. See also subscript to Fig. 2.

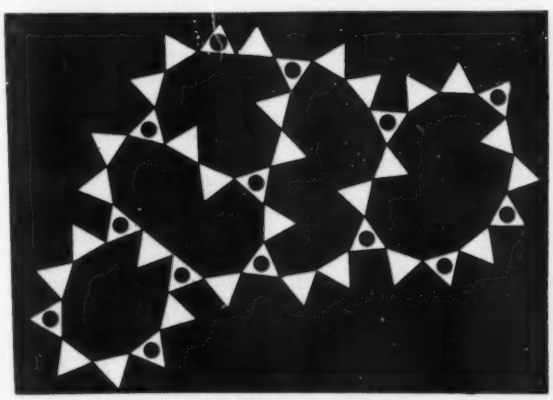


Fig. 5. Constitution of a cohesive tetrahedron layer in a glass when Y = 2⅓. Here, the average length of the chain is 4. See also subscript to Figs. 2 and 4.

properties of glasses of the same Y values (and therefore different numbers of modifiers) are practically the same.

In this connection, we reproduce below a table which is an extract from previous publications.[5] It is true that it only gives the values for both the ends of the range of the values of Y concerned, but it may safely be said that the results are analogous also *in* the range.

TABLE I

Composition of Glass	Y	Fusion Temperature**	Coefficient of Dilatation $\alpha.10^7$
$Na_2O.2SiO_2$	3	1250°C.	146
P_2O_5	3	1300°C.	140
$Na_2O.SiO_2$* ...	2	1050°C.	220
$Na_2O.P_2O_5$	2	1100°C.	220

* This composition devitrifies very rapidly.

** The fusion temperature is defined as the temperature at which the viscosity is equal to 10^2 poises.

The physical properties are thus determined quite characteristically, solely by the degree of polymerization of the network. Broadly speaking, it may be said that strong glasses suitable for industrial uses are those of which Y lies between 4 and 3, whereas those in which Y lies between 3 and 2 are less strong.

When Y = 2, a state is reached where cohesion of the network does not necessarily occur in the manner outlined above, but where we might be concerned only with "infinitely" long chains (Fig. 6). It is true that these are still "linked" by network-modifying ions, for which reason they still seem to exhibit spatial cohesion, but it is obvious that such a network will be very weak and highly sensitive to thermal and mechanical influences.

If a comparison be made between silicates with large metallic monovalent ions, such as Na^+ and K^+, and corresponding phosphates, a notable difference will be seen: the first can no longer exist in the vitreous state, but the second are able to do so.

To form a more precise idea of this striking difference, it is worthwhile recalling a few facts known in the chemistry of organic polymers.

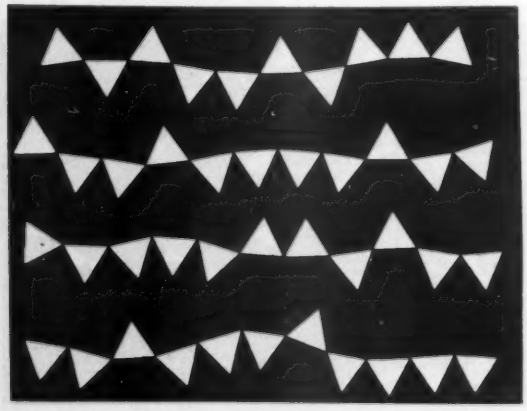
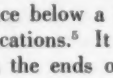
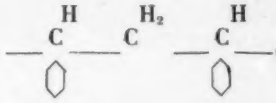


Fig. 6. Constitution of a tetrahedral "layer" in a glass where Y = 2. Here there are only "infinitely" long chains. See also subscript to Fig. 4.

There are certain substances which, suitably treated, possess the capacity for polymerization into long molecules in the form of a chain.

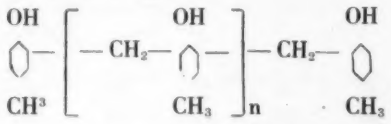
Thus styrene  readily forms a chain



The number of analogous examples is legion. It is quite often possible to prepare a pure dimer and sometimes even a trimer, but usually the reaction is then no longer controllable and a polymer is obtained which is made up of "infinitely" long chains.

Generally speaking, the crystallization of dimers, trimers, etc., occurs very easily, but the polymer is characterized by disorder in the solid state: it is "vitreous". This is quite logical, as it would be purely accidental if the infinitely long series were to order themselves in a strict manner. If two given chains each had two junction points, it would be extremely surprising if the intermediary portions of these chains were exactly to adapt themselves to each other.

An interesting example[6] is:

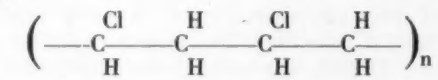


this being the co-polymer of p-cresol and formaldehyde.

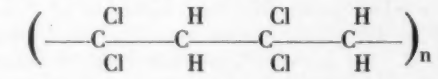
The tetramer (n=2) can be obtained synthetically, and occurs in the crystalline state.

By contrast, up to now the pentamer (n=3) has been obtained only in the vitreous state. Hence it is the sole example in organic polymer chemistry in which the limit between the crystalline and vitreous solidification is sharply defined for a finite length of the chain.

Certain instances are known, however, of substances of which the series are infinitely long, which may solidify in the crystalline form. This will occur when the chain shows a high degree of symmetry. Whereas polyvinyl chloride



has never been obtained in the crystalline form (seeing that the Cl atoms in this molecule are dispersed in no particular order) the polyvinyl chloride:



can be obtained in crystalline form, although it is composed of infinitely long chains F. If, in this case, there are two chains with two junction points, it is reasonably easy for them to adapt themselves since comparatively little energy is required to make them slip against each other.

Many other examples exist. The co-polymer of glycol and of o-phthalic acid:

(*Continued on page* 100)

BORATES FOR THE GLASS INDUSTRY

By M. H. PICKARD, Technical Director

Pacific Coast Borax Co., Div. of Borax Consolidated, Limited, New York, N. Y.

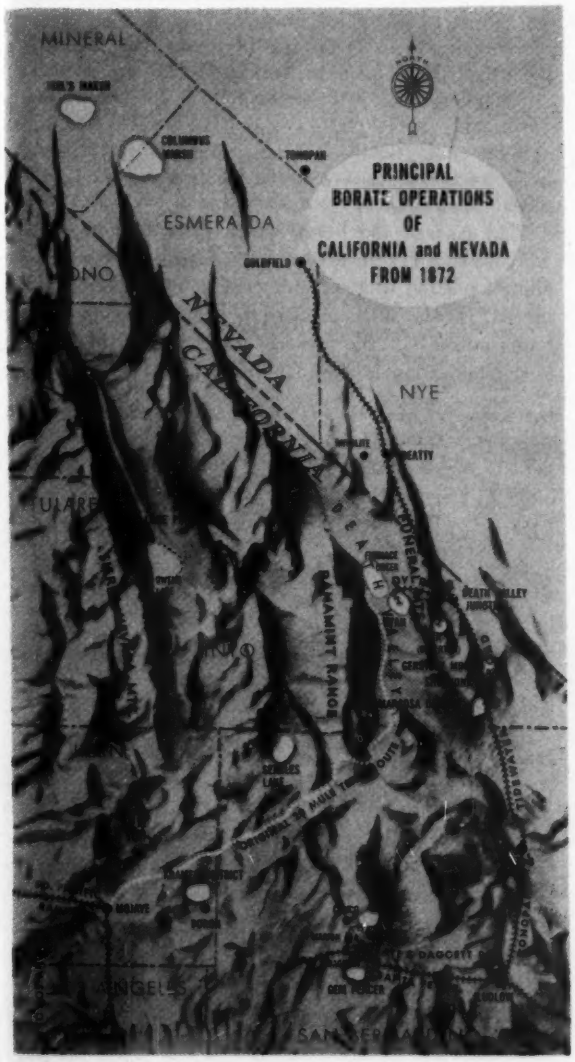
This paper, which was given at the Fourteenth Conference on Glass Problems, will follow the same general pattern as the other papers given on the different classes of raw materials used by the glass industry, viz., (1) importance in glass manufacture, (2) status of future supply, (3) a discussion of quality considerations, manner of arriving at supplier-customer specifications and special problems encountered in shipping, conveying and storage, (4) descriptive comments on general unit processes and operations involved in the manufacture of the various boron-containing products. For the sake of continuity, a few words will be devoted to the different processes involved in extracting and repairing the borates for your industry.

All of you, I am certain, realize the domestic borate deposits are practically all located in the State of California. The exact locations of the deposits now being worked, as illustrated in the map of California, are at Boron, at Shoshone, at Searles Lake and at Owens Lake. At Boron, the ore occurs in bedded deposits covered with an alluvial overburden from 100 to 400 feet thick. The sodium borate minerals found here are: Tincal, the decahydrate form of sodium tetraborate, and Rasorite (Kernite), the quadrihydrate of the tetraborate. The deposit at Shoshone is also a bedded deposit and contains both the minerals Ulexite and Colemanite, which are, respectively, a sodium calcium borate and calcium borate. Here, crude ore is mined and sold directly as such. The borates at Searles Lake are contained in a brine which occurs in a porous, crystalline salt magma. Owens Lake is a dry lake from which some quantities of soda ash and lesser quantities of borax are recovered. The Boron and Searles Lake deposits probably produce 90% to 95% of the world's supply of borates.

Due to the nature of the deposits at Boron and Searles Lake, the recovery processes are entirely different. At Boron, conventional mining practices are followed. The two methods most frequently used are (1) shrinkage stope and (2) the room and pillar method. In the first, winzes or drifts (tunnels) are run into the ore body from a main haulage way. Bins or pockets are constructed which discharge to the level below. The hanging wall or top of these stopes are drilled and blasted. After blasting, enough ore is withdrawn to allow miners to go into the stope and drill another round of holes to blast out more ore. This is continued until the top of the ore body is reached.

In the room and pillar method, rooms are cut in the sides of a haulage way or drift with supporting pillars being left between each room to support the over-burden. In this instance, a miner drills horizontally into the ore. After blasting an ore face, mucking machines are brought in to load the broken ore into ore cars which carry it to storage bins located near the main working shafts. These

Presented before the Fourteenth Conference on Glass Problems, University of Illinois, Urbana, Illinois.



Bulk handling of Anhydrous Rasorite at Boron, California.

Head frame, Jenifer Mine at Boron.

bins discharge into a skip which hoists the ore to the surface. One of the most modern pieces of mining equipment, a continuous miner, is used in the Jenifer mine. These units work against a vertical face of the ore body and continuously cut it way. The broken ore is discharged directly into an ore buggy or on to a belt conveyor which ultimately delivers it to the ore pocket or bin at one of the shafts, from whence it is hoisted to the surface in a skip.

Completely equipped machine shops and a spare parts store are maintained underground so that the majority of repair work and rebuilding of equipment can be effected with a minimum of delay.

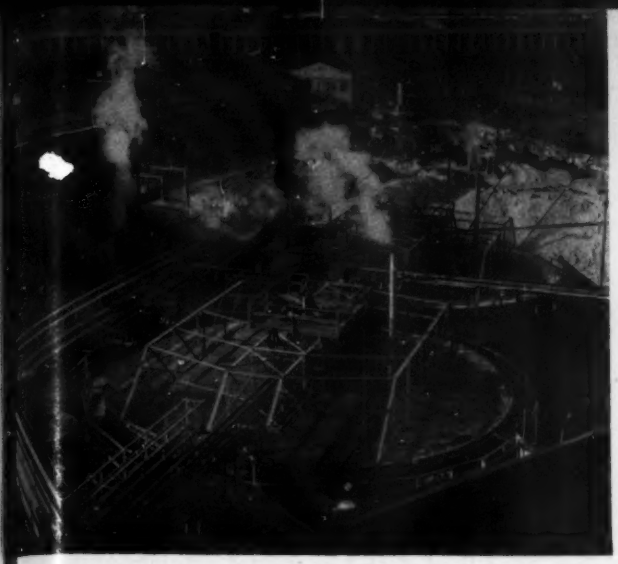
Continuous miner used in the Jenifer Mine at Boron.

At the surface, the mined and partially crushed ore is loaded into rail cars for shipment. The ore shipped to the mill at Boron is further crushed and critically sized by screening on batteries of hummers and concentrated by passing over magnetic separators, calcined and finally used to produce Anhydrous Rasorite concentrates. The fused material is cooled, crushed, sized, sampled and stored or loaded directly for shipment. Ore shipped to the refinery at Wilmington, California, is discharged from the ore cars and elevated to ore silos. The ore is next moved into the ore dissolvers where the soluble sodium borates are put into solution. The solution from the ore dissolvers, containing a considerable amount of suspended shale particles, is pumped to Dorr thickeners. In these units, the greater part of the insoluble shale material is separated from the borax solutions. The over-flow solutions from the thickeners are pumped to clarification filters which remove the last traces of the finely divided and suspended shale particles. The discharge from the presses is then pumped to coil coolers equipped with agitators. Salt water from the harbor is used as the coolant. The slurry of crystallized borax and weak liquor discharge into centrifugals which separate the fine granular crystals of borax from the weak liquor. The borax, at this point, may be diverted in one of three directions: (1) to dryers for the production of the regular decahydrate form of borax, (2) to the anhydrous borax plant or (3) to the acid plant for conversion to boric acid.

Since your primary interest is in anhydrous borax and boric acid, the major steps in the two processes will be briefly described.

That part of the borax which is to be converted to anhydrous borax is passed through calciners where the greater portion of the water content of the borax is removed. These calciners discharge the nearly dehydrated borax into a box-type furnace where the remaining water of crystallization is eliminated and the borax is reduced

Belt conveyor carrying ore in the Jenifer Mine at Boron.



Dorr thickeners at Wilmington, California, operations.

Complete underground machine shop, Jenifer Mine.

to a fluid melt. The molten anhydrous borax is discharged onto a pan conveyor similar to that used in the production of Anhydrous Rasorite, where it cools in pancake-like flakes. These are later crushed and sized and either stored in bulk or in bags, or bulk-loaded directly into hopper or box cars or in sacks into box cars. The loading of goods in box cars, either in bulk or sacks, is very carefully supervised in order to assure delivery in the best possible condition.

The borax diverted to the boric acid plant is conveyed to reactors where it is reacted with sulfuric acid. The boric acid, now in a slurry form, is next separated from the process liquors, redissolved, adjusted for acidity, filtered, cooled in coil coolers similar to the borax coolers or in air coolers where the boric acid is recrystallized. The separation of the boric acid from the mother liquor is done by centrifugals similar to those used in the borax plant. The wet, granular boric acid is dried after which it is bulk-loaded into box or hopper cars or sacked for storage or shipment.

The treatment of the brines taken from Searles Lake utilizes an entirely different process. Due to the complex composition of these brines which contains, in addition to borax, sodium chloride, sodium sulfate, potassium chloride, sodium carbonate, as well as other soluble salts in lesser concentrations, the process for separating and producing the different brine constituents in a pure form requires an equally complex process. The brine contains approximately 63% water, a considerable amount of which must be removed by evaporation before crystallization of the different salts can be effected. It has been said that the phase rule was made to literally do a "hop, skip and a jump" in the Trona process.

Briefly, the brine is pumped from the wells, driven into the porous salt body of the lake and concentrated in triple effect evaporators with cycled mother liquor.

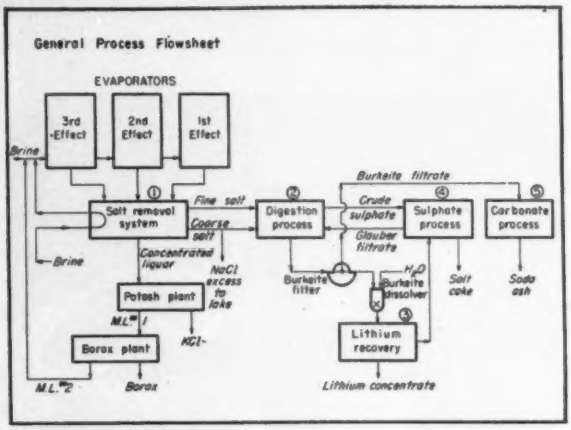
The general flow sheet shows the various basic stages in the Trona process. Since we are mainly interested in the production of borax and boric acid, comment will be confined to that part of the process.

During evaporation, sodium chloride and burkeite, a double salt (sodium carbonate and sulfate), and other salts separate from the liquor and are classified in a

Borax centrifugals used for separating crystal borax from mother liquor at Boron.

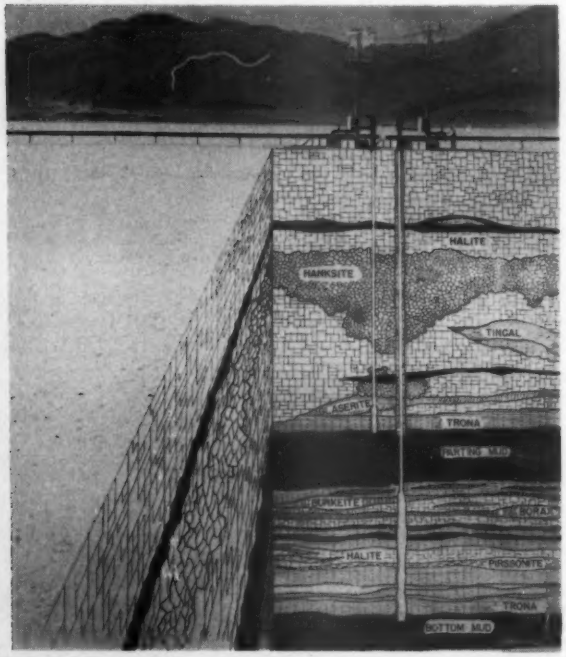
Boron mill at Boron, California, plant.

Aerial view of plant at Trona, California, where borax and boric acid are produced from Searles Lake brine.



The Trona process for production of borax.

Cross-section of Searles Lake deposit.



continuous salt removal system. The fines, mainly burkeite, are sent to a digester process for further processing. The hot, concentrated liquors from the main evaporators are cooled rapidly in the potash plant to crystallize potassium chloride. The mother liquor from the primary potassium chloride coolers is further cooled to crystallize borax.

Once this borax has been refined, its conversion to an anhydrous form is basically the same as has been described, namely, calcining, fusing to a molten state, cooling and grinding. The equipment used, however, may vary as cooling of the fused borax is done in a continuous molding conveyor. The method of manufacture of boric acid likewise is essentially the same.

The exact year when borax was first used in the manufacture of glass is not definite and possibly not significant to the reader. A historical reference indicates that some glazes containing borax appeared in China, sometime before 300 A.D. A Persian is credited with introducing them.

The fact that approximately 20% to 25% of the annual domestic production of B_2O_3 is used in the manufacture of various types of glass is, in itself, a testimony to the importance of borates to the glass industry. Another 20% to 25% of the borates produced are consumed by the vitreous enamel and glaze manufacturers which, in a sense, fall in the same category of glasses. Applying these percentages on the 583,828 tons of hydrated borax reported produced in 1952, we arrive at an estimated annual consumption by all the above industries of 233,531 tons. Borates are *most* important to the glass industry.

The value of borax as a flux undoubtedly accounts for its early use in the manufacture of glazes and artificial gems. This same property of borax probably influenced Michael Faraday to use it in the preparation of lead oxide-containing glasses for optical purposes. I need not tell you it is still an excellent and important flux in many glass batches.

Otto Schott and his collaborators at Jena, near the end of the 19th century, demonstrated that boric oxide, when used in glasses within certain limits of composition, reported such properties as improved durability, increased resistance to thermal shock and reduced thermal expansion, which ultimately led to the development of the group of borosilicate type glasses with their valuable properties. Again, I need not remind you that substantial quantities of boric oxide are now used in the production of the ever-widening variety of borosilicate type glasses used in the production of laboratory and pharmaceutical ware, household utensils, tableware, industrial piping, sealed beam headlights, light bulbs, insulation, fiber glass for reinforced plastics and multiple other uses, some structural glasses and some container glasses.

The advantages of using boric oxide for improved properties of optical glass also dates from the efforts of Abbe and Schott before the turn of the century. It is well-known that boric oxide is a major constituent in borosilicate, crown, medium barium crown, and in many special glasses made from zinc and cadmium borates and borates of lanthanum, tantalum and thorium.

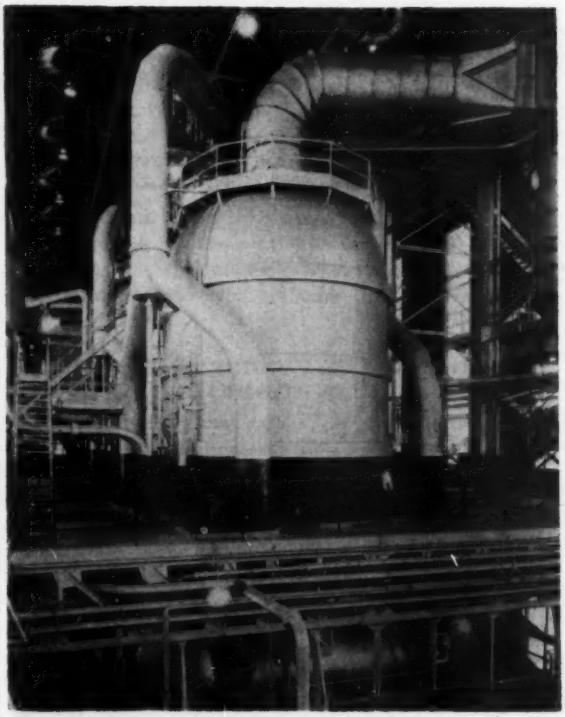
Eventually, it was demonstrated that borax, when used as a minor constituent in soda-lime-silica type glass for the production of plate glass and containers, is a very good flux and aids in melting and fining, as well as im-

parting to a lesser degree, due to the smaller quantities added, many of the desirable properties of the borosilicate glasses.

During the early thirties, borax was introduced into many of the glass container ware batches in the country. Since that time, it has enjoyed both the positions of a "comfortable walking stick" and a "whipping boy". Its virtues as a flux and the fact that it will improve furnace operations have been demonstrated. Some manufacturers insist that the boric oxide content maintains the chemical durability of their ware at a high level, thus enabling them to meet strict customer specifications on durability. A brilliant surface, a glass of lower seed count, as well as increased resistance to thermal and mechanical shock, are other beneficial effects which have been claimed and reported. These manufacturers continue to use boric oxide and, from all indications, satisfactorily and economically.

Other producers, either at management, technical or operational levels, in reviewing costs feel or think the cost of borax appears out of line with the costs of other batch constituents. Borax now assumes the position of the "whipping boy". It is eliminated, substitute constituents are introduced, batches are adjusted; furnace temperatures are increased, fuel consumption goes up, larger tanks are constructed to give a larger melting area. The number of rejects may increase and quality may be affected. Quarterly or annual manufacturing cost reports may reflect apparent economies. Can one be certain that such cherished assets as customer good will and satisfaction are being maintained at the same high level; that the quality of the glass containers now being produced is equal; or, more important, has the quality of the containers been improved?

Giant, triple-effect evaporators at Trona, in which millions of gallons of brine per day are concentrated.



Molding conveyor for cooling ingots of anhydrous borax prior to grinding and screening at Trona, California.

I need not remind you that the container field is a competitive one. Glass containers have for a long time been crowded by tin, then paper, and now plastic containers are being used to pack some products formerly packaged in glass. It is not being too visionary to suggest that containers from aluminum may be further developed or a combination of aluminum and plastic may be introduced. You may also rest assured that every effort possible is being made to improve the properties of these other containers and, thereby, make them more competitive. I feel, and I am certain the reader must feel, such competition is a challenge which must be accepted by the industry and by those of you who are responsible for maintaining the production of glass containers of a quality which will assure their position as the ideal container. I suppose I can be accused of having an axe to grind, but if the importance of borax as a glass raw material is not fully recognized by you in the industry, then we of the borax industry have been remiss in our responsibilities to you. On the other hand, if you, recognizing its importance, have not utilized it to the best advantage, you have been remiss in your responsibilities to the glass container industry.

I fully appreciate that the manufacture of glass is a very complex operation involving a tremendous number of variables. Such variables start with the diverse raw materials used and continue on throughout the entire manufacturing process. The relative merits of different raw materials, both major and minor, their relative costs, their effects on the glass, different batch compositions, furnace designs, melting and forming practices, and quality of ware are all subject to many controversial

(*Continued on page* 108)

RECENT TRANSLATIONS OF RUSSIAN PAPERS OF INTEREST TO THE GLASS INDUSTRY

A GLASS TANK WITH FORCED COOLING OF THE SIDEWALLS

An experimental glass tank, for which some advantages are claimed, is described by the inventor, M. I. Kozmin, in *Steklo i Keramika* (Glass and Ceramics) **9**, No. 6, p. 11 (1952).

The essential part of the invention is shown in Fig. 1. A metal plate (1) is attached to the external face of the sidewall (along the melting end) in such a manner that the upper rim of the plate is 50 mm. higher than the upper edge of the sidewall. The tank is filled so as to raise the melt level above the top of the sidewall and below the upper rim of the metal plate. Thus, the refractories of the sidewall are fully submerged and suffer less corrosion than in the customary furnaces.

In Fig. 1, part 2 is the support of the metal plate (1). It is attached to the outside wall of the furnace by rivet 3. The metal plate is cooled by steam flowing through pipe 4 or air pumped through pipe 5. The metal plate consisted of sections loosely screwed together as shown in the right-hand side of Fig. 1. This was necessary to avoid distortion because of the heat expansion of the plate.

In Fig. 2, the corrosion of mullite blocks with and without metal plate is compared. The figure illustrates the state after 12 months of service. It is seen (the left-hand side of the figure) that, in the usual arrangement, a groove, 140-160 mm. deep, was eaten in the block at the level of the melt surface. In the presence of the metal plate, the top of the block was eaten away, but the greatest depth of corrosion was 60 mm. only. 1 is the top surface, 2 is the internal surface of the block.

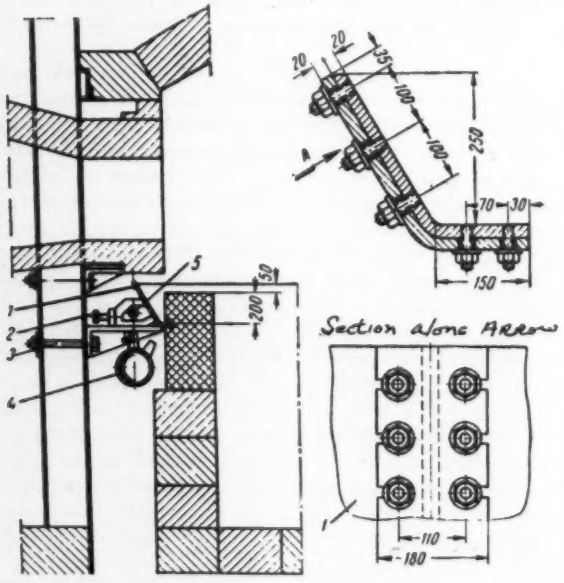


Fig. 1.

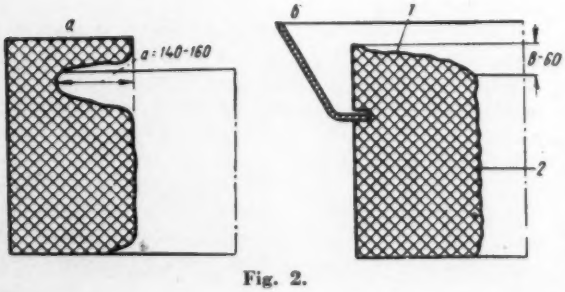


Fig. 2.

EFFECT OF ALUMINA ON THE SURFACE TENSION OF GLASS

M. V. Okhotin and I. G. Bazhbeuk-Melikova report in *Steklo i Keramika* (Glass and Ceramics) **9**, No. 6, p. 3 (1952) some measurements of the surface tension carried out by their modifications of the filament extension method, reviewed in THE GLASS INDUSTRY in January 1953. The following table lists the results obtained:

Composition		Surface Tension (Dynes/cm) at			
SiO_2	Al_2O_3	750°C.	770°C.	790°C.	810°C.
	Group 1.	Na_2O 16,	CaO 6,	MgO 3%	
74	1	304	295	286	277
73	2	294	286	278	269
72	3	300	291	282	272
70	5	321	312	303	294
	Group 2.	Na_2O 16,	CaO 8,	MgO 3%	
73	0	297	290	284	277
72	1	301	293	286	278
71	2	292	285	278	270
70	3	296	290	282	276
68	5	310	302	294	286
	Group 3.	Na_2O 13.5,	CaO 8,	MgO 3%	
75.5	0	297	288	280	—
74.5	1	317	309	300	—
73.5	2	306	297	288	—
72.5	3	311	303	294	—
70.5	5	332	322	312	—

The glasses were prepared in porcelain crucibles at 1470°C. The increase of surface tension, due to substituting a small percentage of alumina for silica, shows why small additions of alumina are advantageous in the drawing of sheet glass.

THE ADHESION TEMPERATURE OF GLASS-TO-METAL

The lowest temperature at which glass drops still adhere to steel and cast iron was determined by V. T. Marinina, see *Steklo i Keramika* (Glass and Ceramics) **9**, No. 8, 8 (1952). The method is not exactly described. The results are summarized as follows:

The adhesion temperature is higher the better the oxidation resistance of the iron alloy at high temperatures. Thus, cast iron No. 4, containing 2.9% total carbon, 1.45% manganese, 0.70% silicon, 0.064% phosphorous and 0.024% sulfur, had the lowest adhesion temperature (to window glass) of all cast iron samples. No. 15, containing 3.04% carbon, 1.25% manganese, 1.52% silicon,

0.113% phosphorous and 0.016% sulfur, belonged to the middle group, and No. 8, with 3.35% carbon, 0.73% manganese, 2.54% silicon, 0.38% phosphorous, 0.12% sulfur, 0.11% chromium and 0.20% nickel, had the highest adhesion temperature. The range of adhesion temperatures valid for steels was roughly identical with that for iron.

Two glasses were tested. Their compositions were (in %):

	SiO_2	CaO	MgO	Al_2O_3	Na_2O	K_2O	B_2O_3
Window glass	73.0	5.5	3.9	1.0	16.6	——	——
Borate glass	66.0	0.25		3.5	3.9	5.35	20.35

The adhesion temperature of the borate glass was lower than that of the window glass. Thus, for the three iron samples characterized above, these temperatures were

	Cast iron	No. 4	No. 15	No. 8
Window glass		620°C.	650°C.	690°C.
Borate glass		595°C.	580°C.	595°C.

SURFACE CONDUCTANCE OF GLASSES IN A HUMID ATMOSPHERE

Some interesting measurements and calculations of the surface conductance can be found in A. Ya. Kuznetsov's paper, Russian *Journal of Physical Chemistry*, **27**, 657 (1953).

Six different glasses were studied. Their composition is not given, but the Fourcault glass will not be much different from the usual in this country, and No. 23 is the main laboratory glass in Russia. See also the composition of glass No. 46 in the abstract entitled "Viscosity of Sodium-Calcium-Aluminum Silicate Glasses."

Table I lists in columns 2-5 the surface conductance in reciprocal ohms at 20°C. and different relative humidities. Column 7 shows the approximate thickness of the surface film on the glass kept at 98% relative humidity. This film has optical properties different from those of the bulk glass, and its thickness is determined from the ellipticity of the reflected light by the equation due to Drude. The thickness is expressed in Ångstrom's units.

If it is assumed that the surface layer in which electricity moves is identical with the surface film as found by optical means, then the specific electric conductivity of the surface layer is equal to surface conductance (column 6) divided by the thickness shown in column 7. Thus, column 8 is obtained. The conductivity is expressed, as usual, in reciprocal ohms per centimeter. (One Ångstrom unit is 10^{-8}cm). The liquid volume (i.e., the volume of the pores) in the surface layer is believed to be one-sixth of the total volume of the surface film. Hence, the specific electric conductivity of the liquid filling the pores is 6 times the conductivity shown in column 8.

Thus, it appears that the surface conductance is caused by a solution of glass in the atmospheric moisture condensed on the glass surface. The specific conductivity of the solution thus produced is, according to Table I, ap-

Table I

Surface conductance of six glasses

Glass	Relative humidity in %					Film thickness	Spec. elec. conductivity
	0	33	50	80	98		
Fourcault	3×10^{-13}	10^{-12}	10^{-11}	5×10^{-10}	4×10^{-9}	70	6×10^{-3}
No. 23	2×10^{-15}	5×10^{-15}	10^{-13}	10^{-10}	2×10^{-10}	60	3×10^{-4}
No. 46	10^{-14}	2×10^{-14}	5×10^{-14}	5×10^{-11}	10^{-10}	50	2×10^{-4}
ZS-4	6×10^{-15}	10^{-15}	10^{-14}	2×10^{-11}	6×10^{-11}	60	10^{-4}
K-8	3×10^{-15}	4×10^{-14}	3×10^{-12}	3×10^{-10}	7×10^{-10}	60	10^{-3}
TK-5	10^{-14}	3×10^{-13}	2×10^{-12}	3×10^{-10}	10^{-9}	50	2×10^{-3}

Table II

Surface conductance of TK-5 at 20° and 98% relative humidity

Film thickness (Ångstroms)	Surface conductance rec. ohms	Conductivity of the film rec. ohm/cm.	Spec. cond. of surface soln. rec. ohm/cm.
700	10^{-9}	1.3×10^{-4}	8×10^{-4}
750	10^{-9}	1.3×10^{-4}	8×10^{-4}
1300	3×10^{-10}	3.3×10^{-5}	2×10^{-4}
1350	3×10^{-10}	3.3×10^{-5}	2×10^{-4}

Table III

Surface conductance of silica films on quartz at 20°C.

Film thickness (Ångstroms)	Surface conductance (rec. ohm) at relative humidity of				Cond. of the film rec. ohm/cm.
	33%	60%	80%	98%	
1000	4×10^{-12}	4×10^{-11}	10^{-10}	10^{-10}	10^{-5}
3000	10^{-11}	7×10^{-11}	10^{-10}	2×10^{-10}	7×10^{-6}
5000	2×10^{-11}	10^{-11}	2×10^{-10}	3×10^{-10}	6×10^{-6}

proximately 10^{-3} to 10^{-2} reciprocal ohms per cm., i.e. equal to that of 0.01 *N* to 0.1 *N* sodium silicate solutions. Smaller conductivities would be expected in surface layers produced by leaching with acids, since the acids would dissolve away a part of this sodium silicate (or another electrolyte causing the surface conductance). This expectation was confirmed by measurements on glass TK-5 treated with 0.5% acetic acid. Table II lists the results. It is seen that the specific conductivity of the surface solution, again obtained by multiplying the film conductivity by 6, is some hundred times smaller than for the solution in the atmospheric moisture.

The surface conductance of silica films deposited by a chemical method on the surface of quartz was much smaller still, as shown by Table III. The specific conductivity of the liquid filling the pores is about 5 times as great as the conductivity listed in column 6 because the surface films contain about 20% pores. This conductivity is nearly 10 times that of distilled water. Kuznetsov makes the electrokinetic surface conductivity responsible for this high conductivity value.

The surface conductance of fused quartz was, e.g., 5×10^{-14} at 60% relative humidity and 2×10^{-12} at 98% humidity.

A convincing confirmation of the theory, according to which the surface conductance is the conductance of an aqueous solution on the glass surface, is given by the temperature coefficient of the surface conductance. It was 1.9 to 2.4% per degree C.; that is, equal to that of usual aqueous solutions.

AN AUTOMATIC GLASS CUTTER

V. M. Obukhov invented an automatic glass cutter which he describes in *Steklo i Keramika* (Glass and Ceramics) **9**, No. 7, 19 (1952). In Fig. 1, the upper drawing is a front view, the drawing in the upper right is a side view and

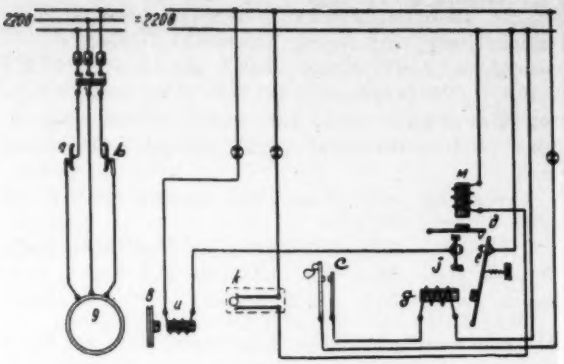


Fig. 2.

the bottom part is the top view of the apparatus. The electric wiring scheme is shown in Fig. 2.

The glass sheet (seen as a vertical line in the upper right of Fig. 1) rises through a slit in frame 1 and presses on the triangle rigidly connected to sleeve 11. This sleeve can be adjusted at any level of the vertical rod 10. This allows adjustment of the width of the glass pane cut off, since this width is equal to the distance between the triangle and the "anvil rod" 13. When 11 is displaced by the glass sheet, it switches on the electrical contacts marked a and b, thus setting motor 9 in motion. Further displacement of 11, also switches on contact c which activates electromagnet g which attracts relay d and thus establishes electric contact between e and j. This activates electromagnet u, which pushes pulley 8 onto the nut on the axle of 9. Thus 8 starts rotating with 9 (3000 revolutions per minute). Pulley 8 carries a loop of rope. When it rotates, the rope is wound on the pulley. To the middle of the rope, cutter 3 is attached. When the rope

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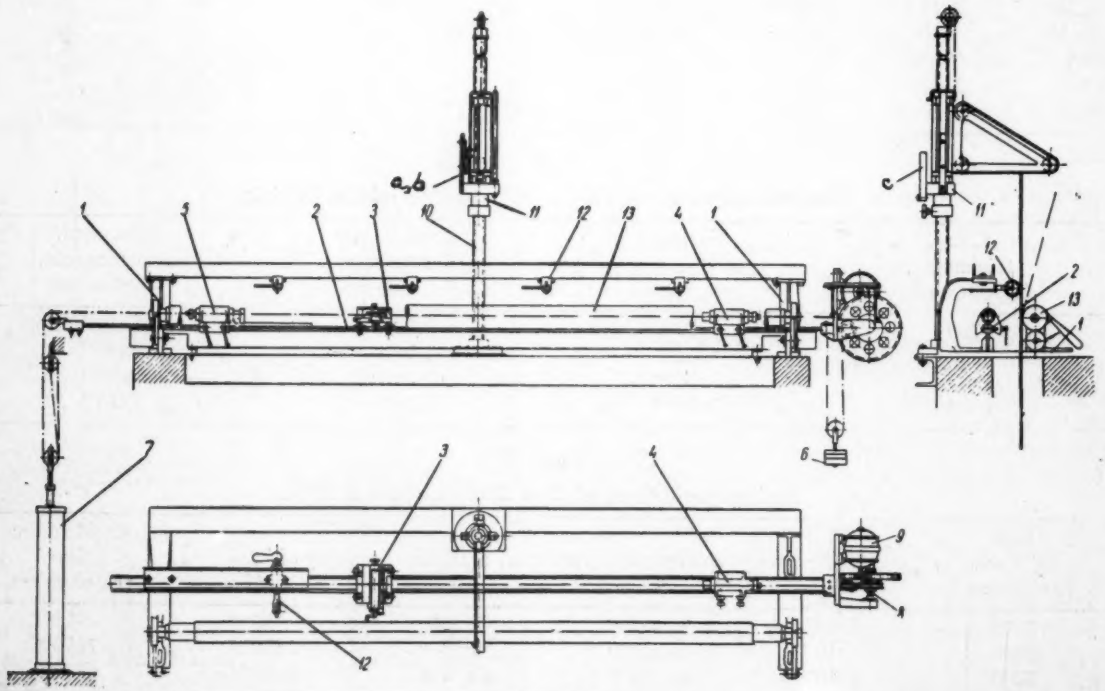


Fig. 1.

MOLDS AND MOLD PARTS SALVAGED

Costly neck rings, formerly destined for the scrap pile because of stripped threads, are now being repaired with wire screw thread inserts. In addition, substantial labor savings result when inserts are used to repair stripped threads in other parts of glass molds, such as baffles, blanks and blow molds. The Glenshaw Glass Company, Glenshaw, Pa., saves hundreds of dollars annually using this thread repair method.

Stripped thread repairs were formerly made by the build-up-by-weld method, an operation that required an average of two man-hours per hole. Now, by installing an insert in the stripped hole, the job can be done in approximately ten minutes. Severe warping often resulted when neck rings were repaired with weld. Scrapping neck rings cost this company an average of $10.00 per ring. A small investment for inserts and inserting tools, both supplied by the Heli-Coil Corporation, Danbury, Conn., enables them to salvage all neck rings.

Fig. 1. Drilling out stripped threads in blank mold.

The scope of the former thread repair problem becomes evident when you consider the operations required. First, a sandblasting operation cleaned out the damage hole. The hole was then drilled out, and the mold heated and welded. Another sandblast operation cleaned off the scale that formed in the heating operation and finally the weld was drilled and tapped. Occasionally, the heat developed in the welding operation warped the larger molds and it then became necessary to machine or file them to proper size.

Repairing stripped holes with inserts involves only three operations: drilling out the hole, tapping and installing the insert. The installation is made with simple inserting tools which wind the inserts into the tapped threads. Although no amount of vibration or screw turning will loosen them in service, they can be quickly and easily removed with an extracting tool if this should become necessary.

Inserts have been used successfully in aluminum, magnesium, die-cast metals, iron, steel, brass, bronze, wood and plastic. Many industries, including steel mills and manufacturers of automobiles, airplanes, electrical equipment, calculating machines and paint brushes, have installed inserts in original equipment, as well as using them for repair and salvage work. Installing inserts in original equipment eliminates thread repair problems in the field, minimizes boss thicknesses, and provides stronger threads that do not wear, strip or corrode. Inserts conform with standard specifications for screw threads as published by the National Bureau of Standards.

Fig. 2. Here, workman is tapping hole prior to insert installation.

Fig. 3. Installing the insert.

SENSITIVE CORROSION MEASUREMENTS WITH AN INTERFEROMETER

An interferometer procedure is being used at the National Bureau of Standards for studies of the corrosion resistance of such materials as optical glass, porcelain enamel, quartz and other natural and artificial silicates, and various metals. The method is believed to have value for comparing and predicting the chemical durability of various materials. Although interferometers have been widely used in science and industry for such problems as checking the accuracy of block gages, measuring expansion and checking optical "flats", they have apparently been used very little in previous studies of corrosion resistance. With the highly sensitive interferometer method, corrosion to a depth of as little as 1 or 2 ten-millionths of an inch can be detected on optically flat specimens.

In the NBS technique, devised by Robert G. Pike and Donald Hubbard of the Bureau's mineral products laboratories, specimens are ground and polished to optical flatness and then immersed to half their depth in the desired corrosive solution. After the desired length of time they are withdrawn, rinsed and dried, and covered with an optically flat piece of quartz. Using a conventional interferometric viewing apparatus of the Pulfrich type, and with an unfiltered helium lamp for illumination, the displacement of the optical interference fringes at the level-of-solution line of the specimen is observed.

As seen by the observer looking into the eyepiece of the instrument, these interference fringes are vertical parallel lines. If the uniform flatness of the specimen under study has not been impaired by the corrosive solution, these fringes are straight and continuous. However, if the previously-immersed part of the specimen surface has been sensibly attacked, each of the vertical fringes is shifted laterally at the point where it crosses the change-of-thickness line. If, as sometimes happens, the solution has caused swelling of the specimen, the lateral shift is in the opposite direction. A lateral shift equal to the space between two adjacent fringes corresponds to a dimensional change in the specimen amounting to one-half wavelength of light, or roughly 0.3 micron. (A micron is a millionth of a meter or about 40 millionths of an inch.) With careful use of the interferometer, changes in specimen thickness of as little as 0.003 micron can be detected.

For further details, see "An Interferometer Procedure Applied to the Study of the Chemical Durability of Silicates, Enamels, and Metals," by Robert G. Pike and Donald Hubbard, J. Research NBS 50, 87 (Feb. 1953), NBS Research Paper 2394. See also, "Studies of the Chemical Durability of Glass by an Interferometer Method," by Donald Hubbard and Edgar H. Hamilton, J. Research NBS 27, 143 (1941), NBS Research Paper 1409.

Fig. 1. Using an interferometer to measure the amount by which a corrosive solution has eaten away the surface of an optically flat specimen. This highly sensitive method of studying chemical durability permits detection of corrosion to a depth of as little as 1 or 2 ten-millionths of an inch.

Fig. 2. Withdrawing an optically flat specimen of glass from a beaker of corrosive solution in which the specimen has been immersed to half its depth. At the left are a number of other specimens whose chemical durability was studied at NBS by the sensitive interferometer method. Materials include silver, platinum, brass, porcelain enamel, and various natural and artificial silicates.

Silicates studied by this procedure at NBS were quartz, fused silica, opal, obsidian, flint, and pitchstone. Porcelain enamels studied were acid-resistant, class A; "glass-lined" tank; and acid-resistant, class D. Metals were cold-rolled steel, aluminum, copper, brass, silver and platinum. The corrosive agents ranged from concentrated sulfuric acid (H_2SO_4) to 5-per cent sodium hydroxide (NaOH) solution. Exposure times were as short as one minute and as long as several weeks. Temperature in most cases was held at 80°C.

A number of interesting and sometimes unexpected results were obtained. Swelling of the immersed surface, rather than attack, was found in several cases. For instance, crystalline quartz showed definite swelling after two weeks at 80°C. in an acid solution (pH 4.1). Opal —like quartz, a form of silica (SiO_2)—showed swelling of nearly 1 fringe of light at pH 2 and continued at a similar level to about pH 8; between pH and pH 11, however, the swelling changed rapidly to an attack of 3½ fringes. Although brass was attacked by strongly acid and strongly alkaline solutions, there was a slight indication of swelling in the more nearly neutral solutions. Such apparent swelling could perhaps be caused by

(*Continued on page* 106)

Inventions and Inventors

Feeding and Forming

Refractory Feeder Chuck. Fig. 1. Patent No. 2,654,186. Filed April 21, 1949. Issued October 6, 1953. One sheet of drawings. Assigned to Emhart Manufacturing Company by Karl E. Peiler.

A novel means is revealed for replaceably holding a vertically reciprocating chuck in a glass feeder. The details of the implement chuck are best seen in Fig. 1. The main clamping part 181 is suspended by an integral vertical shank 190, which may be substantially U-shaped or semi-cylindrical in cross-section. The clamp lever 185 is pivoted at 191 intermediately to the shank 190 so that the lever may swing within limits about a transversely extending horizontal axis and the upper end portion of the lever, which is of reduced size and block-like form as indicated at 192, projects upwardly through a radial notch 193 in a flat circular head 194 formed on the upper end of the suspension shank 190. A thrust bolt 195 is threaded through the upper end portion of the lever to bear against an upstanding central boss 196 on the head 194.

When the bolt 207 has been disengaged from the ring member, the lever 201 may be swung upwardly and slid longitudinally for a limited distance about the pin 203 so as to be out of the way of the chuck and the suspended refractory plunger 48. These then may be lifted through the ring member 199 and for this purpose a hoist (not shown) may be attached in a conventional or any suitable manner.

The patent contains five claims and the references cited were as follow: 1,761,372, Stenhouse, June 3, 1930; 1,844,847, Good, Feb. 9, 1932; and 1,884,967, Algeo et al., Oct. 25, 1932.

Feeder Spout. Fig. 2. Patent No. 2,654,185. Filed December 21, 1949. Issued October 6, 1953. One sheet of drawings. Assigned to Emhart Manufacturing Company by William T. Honiss.

An improved glass feeder refractory spout bowl is shown in Fig. 2. This bowl is less vulnerable to cracking than conventional spout bowls.

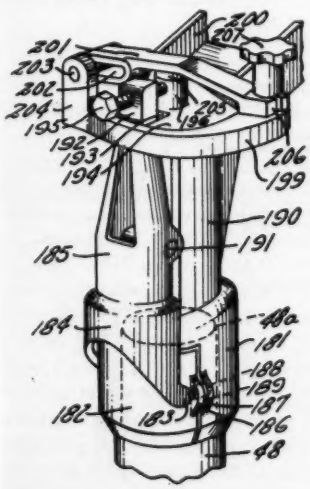


Fig. 1.

The spout outlet includes a removable refractory orifice ring 13 of inverted frusto-conical or downwardly tapering shape. This orifice ring is applied to the lower end of the outlet wall 4 and sealed by suitable luting 14. The orifice ring is carried in a dish-shaped metallic holder 15 having an opening in its bottom at 16 to accommodate

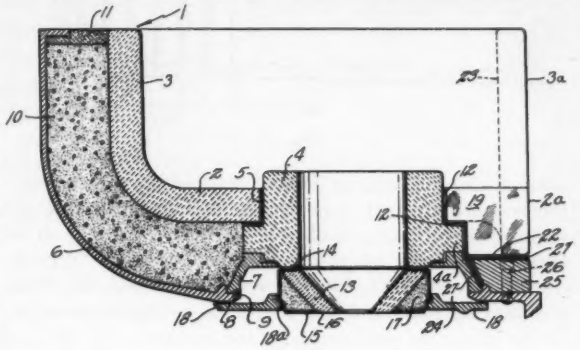


Fig. 2.

the extreme lower discharge end of such orifice ring. Heat insulating material 17 fills the holder 15 around the orifice ring.

A saw-cut or slit 19 is provided in the bottom wall 2 of the spout bowl from its rearward edge to and through the wall of the opening 5 which accommodates the outlet wall 4. This saw-cut or slit may be in the order of about 3/32-inch wide in a full size spout bowl and is located approximately intermediate the width of the spout bowl bottom wall.

The saw-cut or slit 19 prevents any tension stress sufficient to cause cracking from building up in the refractory clay of the spout bowl when it is being heated up from room temperature to operating temperature.

The patent contains four claims and the following references were cited: 603,330, Hartman, May 3, 1898; 1,909,152, Peiler, May 16, 1933; 2,016,382, McBurney, Oct. 8, 1935; and 2,217,182, Peiler, Oct. 8, 1940.

Furnaces

Reduction of Convection Current by Means of Electric Melting. Fig. 3. Patent No. 2,658,093. Filed August 15, 1949. Issued November 3, 1953. One sheet of drawings. Assigned to Societe Anonyme des Manufactures des Glaces et Produits Chimiques de Saint-Gobain by Pierre Henri La Burthe.

An object of this invention is to construct furnaces having means for the control and elimination of convection currents.

In Fig. 3, 10 refers to a glass furnace of rectangular shape having at one end a melting zone, in the middle a fining zone, and at the other end a working zone. At the opposite sides of the working zone are Joule effect electrodes 11-12 constructed and arranged to oppose the convection currents. These electrodes are separated by electrode 15 of the idler type, which has higher conductivity than the bath and serves to constrain the Joule effect currents to a narrow lane parallel to the wall.

By regulating the quantity of energy expended in the glass through the electrodes adjacent to the walls, it is possible to compensate for the heat lost through the furnace wall. In thus nullifying the cooling action of the vertical walls, the cooling of the glass only occurs, practically speaking, at the surface of the bath and through the bottom. Consequently, there is established in the working

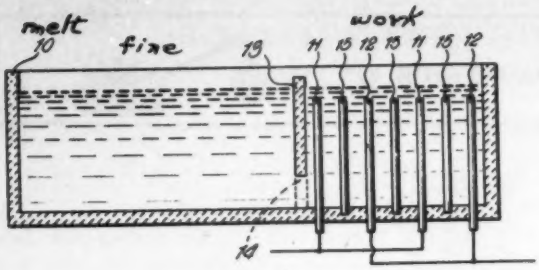


Fig. 3.

zone of the furnace, or in any selected part, a regular temperature gradient from the free surface to the bottom, the isothermal lines extending practically horizontal. It is therefore possible to withdraw the glass at a uniform temperature through the orifice of withdrawal, or from the working zone, and this results in an improvement in all the glassware produced from the furnace.

The patent contains seven claims and 20 references were cited.

Electric Melting of Glass. Fig. 4. Patent No. 2,658,095. Filed July 7, 1945. Issued November 3, 1953. Two sheets of drawings. Assigned to Societe Anonyme des Manufactures des Glaces et Produits Chimiques de Saint-Gobain by Pierre Arbeit, Robert Dubois and Roger Emile Lambert.

A method of melting is shown in Fig. 4 in which the heating is obtained by passing an electric current through the glass, both by means of electrodes in contact with the glass and suppressing the contact of the glass with the electrodes when the melting is ended.

An electric current is supplied to the glass by means of electrodes 7 located in the melting compartment 4. These electrodes are placed vertically and penetrate through the bottom of the tank. No electrode is placed in the compartment 5 and, moreover, a partition 8 constituting an obstacle is interposed between compartments 4 and 5. Such partition is so arranged that it lets the glass flow from compartment 4 to the compartment 5, but it prevents it from flowing back from compartment 5 towards the electrodes 7. Such result may be obtained by providing in the partition 8 an orifice for the passage of the glass, the section of which is so small that the flow of glass from compartment 4 to compartment 5 due to normal withdrawal of glass leaves no room for the passage of any back current. Such orifice may be situated at any level in the partition 8 separating the compartments 4 and 5. A heating by flame ports 9 and 10 in the melting compartment is associated with the electric heating. The glass is heated in the refining compartment by flame ports 11.

Other modifications of the same principal are shown in which the glass can be melted by means of day tanks or pots.

The patent contains 15 claims and 21 references were cited.

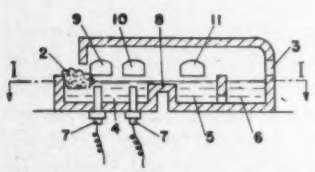


Fig. 4.

Glass Compositions

X-ray Glass. Patent No. 2,657,146. Filed September 29, 1951. Issued October 27, 1953. No sheets of drawings. Assigned to Bausch & Lomb Optical Company by Norbert J. Kreidl.

One of the objects of this invention is to provide a borosilicate optical glass which will be stabilized against discoloration by irradiation of high energy sources such as X-rays. A further object is to provide a borosilicate optical glass which will be stabilized against discoloration by irradiation while still retaining desirable optical properties.

It is said that unless borosilicate crown glasses are substantially free from potassium, they will not be stabilized against discoloration by irradiation even if relatively large amounts of cerium are present. Optical glasses showing desirable properties have the following composition ranges by weight:
SiO_2, 60-70%, B_2O_3 10-20%, Na_2O 10-15%, ZnO 1-5%, Li_2O 0-2%, K_2OO 0-0.5%, SrO 0-2%, BaO 0-2%, Al_2O_3 0-2%, Sb_2O_3 0-5%, CeO_2 0.2-2%.

The refractive indices for these glasses range from about 1.49 to 1.54 and the reciprocal relative dispersions, V values, vary from about 62 to 67.

The patent contains three claims and the references cited were: 2,068,801, Hood, Jan. 26, 1937; 2,564,950, Black, Aug. 21, 1951; and 617,148, Germany, 1936.

Controlled Absorptive Glasses. Patent No. 2,655,452. Filed May 13, 1950. Issued October 13, 1953. Five sheets of drawings (none reproduced). Assigned to American Optical Company by Robert Bowling Barnes and Walter A. Fraser.

Glasses having controlled absorptive characteristics as to the visible and invisible portions of the spectrum have

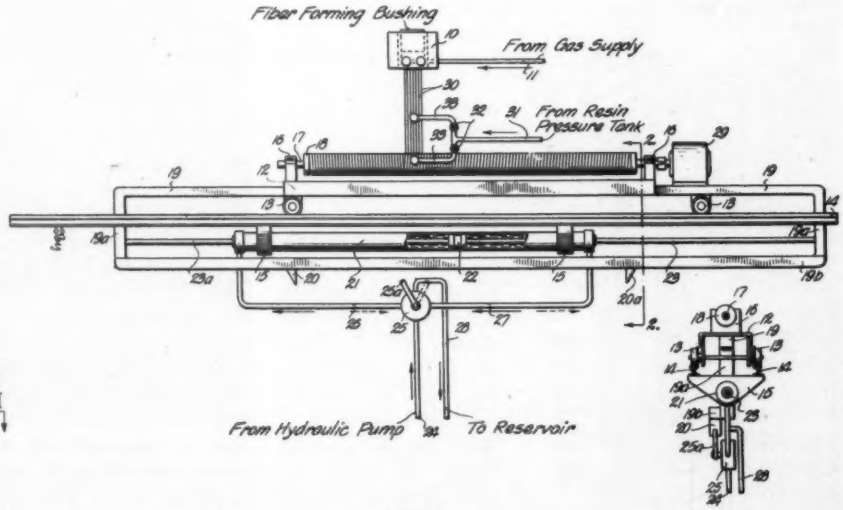


Fig. 5.

been developed. The glasses are of especial interest in cathode ray tube manufacture.

The following characteristics have been considered desirable:

(1) Transmission in the visible portion of the spectrum ranging approximately from 45% to 70% at 400 millimicrons, 58% to 76% at 500 millimicrons, 50% to 71% at 600 millimicrons, and 67% to 80% at 700 millimicrons, and with an average white of from 60% to 75%.

(2) Transmission in the ultraviolet portion of the spectrum of approximately from 2% to 31% at 370 millimicrons, approximately from 0 to 13% at 360 millimicrons, approximately from 0% to 3.5% at 350 millimicrons, and with substantially no transmission below 350 millimicrons.

(3) Absorption in the X-ray portion of the spectrum of substantially all X-rays generated thereby.

These transmission and absorption values apply to glasses when measured in thicknesses of from 5 to 6½ millimeters.

Crown glasses having desirable characteristics have been produced as shown in Table A.

Table A

Ingredients	Amount per cent
Silica (SiO_2)	60-72
Boric oxide (B_2O_3)	0-7
Soda (Na_2O) + Potash (K_2O)	14-20
Lime (CaO) + Lead oxide (PbO)	9-11
Vanadium oxide (V_2O_5)	0.05-0.15
Manganese oxide (MnO_2)	0.4-1.4
Silver oxide	0-0.2
Copper oxide	0-0.4

For X-ray absorption the glasses shown in Table B have been desirable.

The patent contains 16 claims and the references cited were as follows: 1,292,148, Taylor, Jan. 21, 1919; 2,219,-122, Weidert, Oct. 22, 1940; and 2,582,453, Pincus, Jan. 15, 1952.

Table B

Ingredients	Amounts in per cent						
	Batch A	Batch B	Batch C	Batch D	Batch E	Batch F	Batch G
Silica (SiO_2)	67.8	67.8	67.8	67.8	67.35	66.8	66.25
Boric oxide (B_2O_3)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Soda (Na_2O)	9.0	9.0	9.0	9.0	9.0	10.0	10.0
Potash (K_2O)	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Lime (CaO)	7.0	7.0	0.0	7.0	7.0	7.0	7.0
Lead Oxide (PbO)	3.0	3.0	3.0	3.0	10.0	3.0	3.0
Antimony oxide (Sb_2O_3)	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Manganese oxide (MnO_2)	0.6	1.0	0.6	1.0	1.0	1.0	1.0
Vanadium oxide (V_2O_5)	0.15	0.15	0.1	0.1	0.15	0.15	0.15
Copper oxide (CuO)	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Silver oxide (Ag_2O)	0.0	0.0	0.0	0.0	0.0	0.1	0.0

Glass Wool and Fiber

Glass Fiber Drawing Device. Patent No. 2,654,183. Filed May 11, 1951. Issued October 6, 1953. Two sheets of drawings (none reproduced). Assigned to International Harvester Company by Adelbert C. Radtke.

A drawing mechanism is shown which grasps an extensive length of fiber along a sinuous drawing surface while applying a pulling force. The operation is continuous and rapid. This is accomplished by having opposed radial grasping surfaces for receiving the material. The grasping surfaces are biased into light pressing engagement along an extensive length of the fibers by a plurality of fingers. The fingers are arranged to deflect the surfaces of the grasping zone of the mechanism to obtain intimate contact without deforming it. Sinuating of the surfaces of the material by the fingers is highly desirable in order to pull and attenuate the fibers. The drawing unit is well shielded and this reduces air turbulence which otherwise might affect the course of the strand.

The patent contains 19 claims and the following references were cited: 478,383, Great Britain, Jan. 18, 1938 and 512,283, Great Britain, Aug. 31, 1939.

Process and Apparatus for Producing Glass Fibrous Tubes. Fig. 5. Patent No. 2,656,873. Filed May 2, 1949. Issued October 27, 1953. One sheet of drawings. Assigned to Minnesota Mining & Manufacturing Company by Joseph F. Stephens.

This invention relates to a method for producing glass fiber and manufacturing tubular objects such as pipes and refers more particularly to a process for forming glass fiber reinforced tubes as the fiber is spun or drawn.

In operation, glass fibers are drawn in the usual manner from a bushing or spinneret in the lower part of the forehearth 10. The speed at which the mandrel is rotated by a motor 29 will determine the character of the fibers.

When arm 25a is in full line position, as in Fig. 5, fluid is introduced into the left end of the cylinder 21 through pipe 25. Piston 22 moves frame 19 and carriage 12 to the right while the hydraulic fluid to the right of

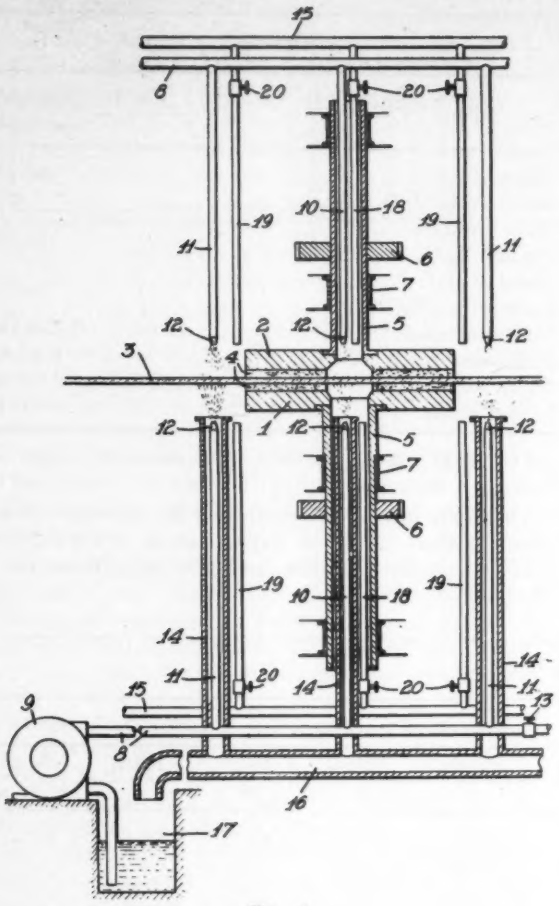


Fig. 6.

the piston is discharged from the right end of the cylinder through pipe 27, valve 25 and pipe 28. When the piston reaches the end of its stroke, fibers 30 will be wound onto the left end of the mandrel and the stroke will be reversed by trip member 20, moving arm 25a to its dotted line position. Hydraulic fluid now is charged through pipe 27 and is discharged through pipe 26 while the mandrel moves to the left and the fibers 30 are distributed upon the periphery of the mandrel in a continuous helix crossing the fibers applied to the mandrel in the previous stroke. In this manner, successive layers of glass fiber are applied circumferentially to the mandrel in successive layers and a tube wall built up to the desired thickness. A binder material such as a resinous substance which may be either thermoplastic or thermosetting is applied to the fiber through pipes 31 and 33.

After the tubular object has been formed on the mandrel 18, it may be removed in any suitable manner.

The patent contains eight claims and 10 references were given.

Sheet and Plate Glass

Process for Producing Polishing Rouge. Patent No. 2,653,081. Filed January 6, 1948. Issued September 22, 1953. No sheets of drawings. Assigned to C. K. Williams & Company by Robert A. Stephens.

Polishing rouges of high purity have been produced by first calcining ferroso-ferric oxide sludges at a temperature of 500°C. to 900°C., to insure oxidation of the iron to ferric oxide and either volatilization of the organic matter or reduction to carbon. The calcined product is then treated with cresylic acid or pine oil by a flotation process to reduce the carbon content.

The patent contains five claims and 14 references were cited.

Rouge for Polishing Glass. Patent No. 2,653,080. Filed January 6, 1948. Issued September 22, 1953. One sheet of drawings (none reproduced). Assigned to C. K. Williams & Company by Robert A. Stephens.

This invention relates to new ferric oxide compositions particularly adapted for polishing purposes and to methods by which such compositions may be produced. The loss of abrasive quality of rouge has been found to arise from the tendency of the carbon remaining in the iron oxide after the calcination to adhere to the polishing pads and in time to coat the same, with the result that the abrasive action of the rouge is substantially diminished.

The improved process comprises calcining a mass of natural bog iron ore at a temperature between 500° and 900°C. which produces iron oxide of a structure having a high abrasive power and leaves free carbon. By forming a slurry of the calcined ore, subjecting the slurry to a flotation treatment, the carbon content of the calcined material is reduced to an amount not in excess of 0.15%. A ferric oxide product of high quality containing substantially only inorganic impurities is thereby produced. By reducing the carbon content of the iron oxide, rouges have been produced capable of maintaining high polishing rates over long periods of time.

The patent contains seven claims and 14 references were cited.

Simultaneous Abrading of Both Faces of a Sheet of Glass. Fig. 6. Patent No. 2,646,655. Filed May 14, 1952. Issued July 28, 1953. Three sheets of drawings. Assigned to Les Glaceries de la Sambre, Societe Anonyme, Auvelais, Belgium by Edmond Laverdisse.

The present invention relates to the feeding of abrasives to glass surfacing tools, i.e. grinding and/or polishing tools working on one or both faces of a sheet or ribbon of glass, and more particularly to the tools intended to work on the lower face of the glass ribbon.

In Fig. 6, 1 and 2 are the upper and lower tools, respectively, of a pair of polishers working face to face on a moving ribbon of glass 3. Abrasive mixture is distributed both to the center of each tool and to the immediate neighborhood of the periphery. In the case of the lower tools, a duct 8, fed by a pump 9, distributes the mixture of abrasive and water to vertical pipes comprising a central pipe 10 and lateral pipes 11. The pipes are terminated by atomizing nozzles 12 which, when the mixture in the pipes is put under pressure, for example on closing of a valve 13 in the duct 8, deliver on to the lower surface of the glass 3 very fine jets by which the mixture is projected on to this surface in the manner of paint from a spray gun. The mixture is thus applied in the form of a thin layer with an adhesion to the glass which it is not possible to obtain by other means and which prevents any loss of the abrasive mixture.

What has been stated with regard to the polishers is obviously also applicable to the grinding tools, regardless of the form and the arrangement of the tools and of the method by which they are supported.

(*Continued on page* 98)

LEHIGH UNIVERSITY BOOKLET STRESSES NEED FOR ENGINEERS

As part of a program to focus attention on the need for more engineers for industry, and at the same time to interest industrial firms in the establishment of scholarships at Lehigh University, the Business and Industry Committee of the University has published a brochure, "More Engineers?", outlining a plan for increasing the number of engineers for industry.

The interesting brochure presents facts and figures concerning the supply and demand for engineers, and points out that the Engineering Manpower Commission estimates that there will be an accumulated shortage of 40,000 engineers by 1954. Stressing lack of funds a primary reason why young men must forego attending college, the University urges corporate financial support for our educational institutions. The sum of $1,500 per year, or $6,000 for the four-year course, will train one engineer. However, the actual cost is less in that firms in the excess profits bracket would pay approximately only 13 cents on the dollar, or $270 per year per boy. Firms in the normal tax bracket would pay 48 cents on the dollar, or $720 per year per boy.

The University, itself, has undertaken a program of its own, aided by its Business and Industry Committee. To date, 30 firms have provided over $300,000 in scholarships and is evidence of the national potential for education when industry as a whole becomes aware of the possibilities.

O-I EXPANSION

Owens-Illinois Glass Company has announced plans for the construction of a big, new glass melting furnace, a new warehouse and other additions at its Bridgeton, New Jersey, glass container plant.

Carl R. Megowen, President, said with the expansion and renovations, the Bridgeton plant will be equal in size and capacity to the largest of the company's glass container plants and one of the most modern in the world.

The new furnace, which will bring Bridgeton's total to eight, will take months to build and should be completed the latter part of 1954. To house it, the south end of the main factory building will be extended 120 feet. The plant's shops will be renovated and expanded to take care of repairs to the additional bottle-blowing machines and mold equipment. Another feature in the building program is the expansion and complete remodeling of the plant cafeteria.

STAUFFER APPOINTMENT

L. Douglas Weiford has been named Assistant to the Executive Vice President in charge of Government Relations by the Stauffer Chemical Company.

Mr. Weiford, who began his career with Stauffer in 1929, was originally office and laboratory manager of the company's plant at Roanoke, Va. A promotion to Director of Government Relations for Stauffer occurred in 1941 when Mr. Weiford was transferred to the company's New York office to become the firm's Washington representative. Then, in 1950, Mr. Weiford moved to Washington to carry on government relations work and to establish a Stauffer office there. In Washington, Mr. Weiford also directs Stauffer government sales work.

ARMSTRONG NAMES GLASS CONTAINER MANAGER

P. S. Holmquest has been named Manager of the Glass Container Department of the Glass and Closure Division of the Armstrong Cork Company, according to an announcement by R. H. Hetzel, General Sales Manager of the Division.

Mr. Holmquest succeeds H. Clayton Seaman, Jr., who died in December. He had been Acting Manager of the Department during Mr. Seaman's illness.

Mr. Holmquest, who formerely was Assistant Manager of the Department, has been a member of the Armstrong Glass and Closure Sales organization since 1937. He is a graduate of Indiana University.

WINNERS ANNOUNCED IN L-O-F COMPETITION

Winners of the $8,000 competition to name the new twin-ground plate glass produced by Libbey-Owens-Ford Glass Company at its Rossford plant were announced by George P. MacNichol, Jr., President.

Sidney Estow, Admiral Glass Company, Hicksville, Long Island, N. Y., was the top winner who will receive 100 shares of L-O-F stock and $1,000 in cash for the winning entry, "Parallel-O-Plate."

Second prize went to D. M. Sullivan, Milwaukee, Wisconsin, for his entry, "Precision-Ground," and third prize was awarded Charles J. Meyer, San Antonio, Texas, who submitted the name "Tru-Plate Glass."

BOOK REVIEW

Temperature Measurement in Engineering, Volume I
By H. Dean Baker, E. A. Ryder and N. H. Baker

Devoted primarily to the widely-used thermocouple technique, this manual on the design, performance and operation of temperature measurement installations stresses specific procedures and their application to actual problems. The authors give not only the general systematic procedure as they have personally developed it, but also accurate descriptions of other published and previously unpublished methods.

In keeping with their workable approach, the authors detail such information as how to compute by given formulas, how to determine a required precision for a special measurement and just how to perform the difficult drilling operations on which proper thermocouple installation depends. Direct means of evaluating expected magnitudes of errors and directions for avoiding them are given, while a complete chapter provides a catalog of special materials needed for a variety of situations. Other chapters cover such topics as conditions affecting temperature measurement, the thermocouple thermometer, indicating instruments, design calculation techniques, installation design types, cemented installation designs and temperature gradient installation designs.

Published by John Wiley & Sons; 179 pages; $3.75.

Surface Durability of Optical Glass

The durability of glass (i.e., its inertness or resistance to chemical attack) is probably its most important asset. If it were not for this inertness, glass surfaces would soon be altered and the important property of transparency would be impaired or would disappear, leaving the product practically useless. Furthermore, any alteration or change in the surface will directly affect the optical properties of the glass and ruin the usefulness of, for example, optical instruments.

The deterioration of optical glass becomes of still greater importance because the glass, when once assembled in a highly complex optical instrument, often cannot be washed or cleaned. The problem is usually complicated further by the fact that optical reticules vary greatly in composition, and hence vary in their ability to resist the attack by moisture. Each instrument may be dependent, therefore, upon the durability of the poorest glass in its optical system. The service such instruments give is dependent, therefore, upon the resistance of the glass to atmospheric attack.

H. E. Simpson recently reported a new test for evaluating the surface durability of flat glass by measuring the "haze" produced. This test has shown promise in evaluating the resistance of glass surfaces to attack by moisture. The important feature of the method is that the products of weathering remain in place on the glass surface being tested and are not periodically removed during the test. The actual conditions which encourage staining and etching of the glass surfaces, namely alternate wetness and dryness, are reproduced.

Various optical reticules were tested by Simpson with the object of comparing the ability of each to resist surface weathering and the results obtained reported in the October 1953 issue of the *Journal of the Society of Glass Technology*.

All samples were prepared from commercial glass. It should be emphasized that each glass was prepared in a similar manner and that all samples were ground and polished so as to present a similar type of surface. The glasses studied represent a considerable variety of optical glasses, and typical compositions of each are indicated in Table 1.

The method consisted essentially of exposing properly prepared samples in an atmosphere of high humidity in a closed Pyrex humidity chamber. The samples were suspended over water by means of Pyrex-glass sample-holders so that no contact contamination would result. The humidity chamber and contents were placed in a 150-watt precision oven so that a controlled two-hour temperature cycle might be maintained. The purpose of the temperature cycle, which varied 5°F. in two hours, was to produce effectively alternate wetting and drying on the surface of the glass, a condition which was highly important to the success of the test. The test was continued for a number of days, the exact length of time being dependent upon the glasses studied. The surface deterioration produced at a given time was measured by determining the amount of light scattered by the glass surface by means of a photoelectric device known as a "haze meter". The haze produced at various other time intervals was then determined on similar samples. By plotting the amount of haze versus time, "haze curves" were obtained that revealed the characteristic break-down of the glass surface with time. The advantage of such curves is that they reveal not only a mathematical estimate of the durability, but also give a comparison of the time involved.

The results of the haze-curve tests show some definite relationships between the various types of optical glasses. Inasmuch as all glasses were prepared in a similar manner and all surfaces were similarly ground and polished,

Table I

Percentage Compositions of Optical Glasses Tested (Typical)

	Glasses								
Oxide	10E Crown	3E Crown	1E Dense Barium Crown	4E Boro-Silicate Crown	11E Crown Flint	6E Light Flint	7E Dense Flint	2E Extra Dense Flint	5E Barium Flint
SiO_2	71.6	71.6	31.0	70.7	67.8	54.3	47.9	38.0	49.2
B_2O_3	—	—	12.0	6.0	—	1.5	—	—	—
Al_2O_3	—	—	8.0	1.0	—	—	—	—	—
As_2O_3	0.7	0.7	1.0	0.3	1.0	0.2	0.3	0.2	0.5
PbO	—	—	—	—	13.2	33.0	42.4	56.8	19.3
ZnO	—	—	—	—	5.0	—	—	—	8.5
CaO	8.6	8.0	—	—	—	—	—	—	—
BaO	2.0	2.6	48.0	—	—	—	—	—	13.0
K_2O	1.0	9.0	—	10.5	9.2	8.0	5.1	5.0	8.5
Na_2O	16.1	8.1	—	11.5	3.8	3.0	4.3	—	1.0

it seemed quite fair to compare these glasses. Glasses 10E and 3E are crown glasses, and are very similar in composition. Both contain a total of 16.1 per cent alkalis. Glass 10E, however, contains 16.1 per cent Na_2O and 1.0 per cent K_2O, while glass 3E contains 8.1 per cent Na_2O and 9.0 per cent K_2O. The glass containing the greater amount of Na_2O (10E) seemed to develop haze a little faster than that containing the greater amount of K_2O (3E). This may be due to the fact that potash silicates are less opaque than similar sodium silicates. This difference in durability is rather slight, but the important fact is that these glasses, which are quite similar to the plate and window glasses previously studied, develop haze much faster than some other types of glass. These flat glasses all developed considerable haze within the first 15 days of exposure, and at the end of 60 days were well decomposed at the surface.

Glass 1E, which was a dense barium crown glass, showed a greater resistance, and at the end of 60 days had developed less than half the amount of haze developed by the crown glasses. Beyond 60 days exposure, the development of haze was extremely slow.

Glass 4E was a borosilicate crown, and showed still greater resistance to attack by moisture. This glass developed less than 10 per cent haze after 60 days exposure, and the subsequent haze was very slight with continued exposure up to 175 days.

The remaining glasses tested were flint glasses, and all showed remarkable resistance to attack by moisture. Glass 11E, which was a crown flint glass, showed the greatest amount of attack of the flint glasses. Incidentally, this glass contained the least amount of PbO of all the flint glasses studied. The greatest amount of deterioration occurred within the first 20 days of exposure, and beyond this and up to 200 days there was little increase in the haze developed. The remaining lead-bearing glasses—6E, which was a flint glass; 7E, which was a dense flint glass; 2E, which was an extra dense flint glass; and 5E, which was a barium flint glass—all showed very little haze when exposed up to as long as 456 days. The crown flint glass (11E) contained 13.2 per cent PbO, and extra dense flint (2E) contained 56.8 per cent PbO. All showed excellent resistance to attack by moisture.

The results of other durability tests on glasses similar to those used in the foregoing haze tests are given below.

Stain tests similar to those used by E. Berger were adopted by F. L. Jones and employed in comparing various optical glasses. The stain test is a rather rapid test which consists of immersing the properly prepared sample in a 1 per cent nitric acid solution at 25° until the light reflected from the surface is a dark blue in color. The time lapse between immersion and the appearance of the dark blue color was noted. The glasses were classified according to the length of time. Glasses 1-V corresponded, respectively, to the following times: $>$ 100 hr., 10-100 hr., 1-10 hr., 0.1-1hr., $<$0.1 hr.

This test was apparently highly selective, and indicated that the dense barium crown (1E) was the worst (Class IV), while the remaining glasses were placed in Class I. This test did not differentiate among the various glasses studied.

F. L. Jones also reported a modified dimming test for optical glasses in which properly cleaned samples were subjected to high humidity for 28 days at a constant temperature of 50°. In order to compare and evaluate properly the surface deterioration produced by such a test, the samples were classified as follows: (1) extremely slow to dim; (2) slow to dim; (3) dims easily; (4) forms nearly opaque surface.

Glasses similar to those used in the haze test were classified respectively as follows: 10E, (3); 3E, (3); 1E, (3); 4E, (1); 11E, (1); 6E, (2); 7E, (1); (2); 2E, (2); 5E, (1).

This type of test obviously correlates more closely with the haze tests. The results show that glasses 10E, 3E, and 1E have the greatest tendency to develop haze. The remaining glasses tested were more resistant, and their exact classification is difficult. The dimming test has classified all these glasses as being either slow or extremely slow to dim. The haze test also indicates that they are quite slow to develop haze. It appears that, when independently applied, these two tests can be correlated.

It was suggested that the superiority of the flint glasses was due to the theoretical fact that lead ions are adsorbed at a glass surface in such a way that their electrical forces will be directed chiefly towards the glass. As a result, they will appear rather inert from the outside. In general, those glasses containing highly polarizable ions appear to be the best from a standpoint of high surface durability.

BAUSCH & LOMB NAMES GLASS ENGINEERING HEAD

C. Cala has been named to head the new Glass Engineering Department in the Chemical Research Laboratories of Bausch and Lomb Optical Company, which, under Dr. Norbert J. Kreidl, Chemical Research Director, have been reorganized from one into three departments: Chemistry, Glass and Glass Process Engineering.

Mr. Cala assumes, with his previous responsibilities, those of a new section on glass processing to be headed by W. Shrewsbury, formerly of Kimble Glass Company.

• Prof. Robert S. Green, Chairman of the Department of Welding Engineering at the Ohio State University, has been named Executive Director of the University's Engineering Experiment Station.

AMERICAN POTASH APPOINTMENT

Calvin L. Dickinson, formerly Plant Manager of the Organic Chemicals Division of Diamond Alkali Company at Houston, Texas, has joined American Potash & Chemical Corporation as Advisory Engineer. Mr. Dickinson has been assigned to the firm's plant at Trona, California.

At the same time, it was announced that Frank A. Jessup has assumed the position of Safety Engineer at the Trona Plant. Mr. Jessup formerly was with Pacific Indemnity Company for 17 years.

• The Newcomen Medal, given only three times before in the history of the U. S. branch of The Newcomen Society, has been awarded to William H. Rowand, Vice President of Babcock & Wilcox Company at a joint meeting of the Society and The Franklin Institute.

Seated, left to right: F. H. Norton, H. H. Blau, J. V. Fitzgerald, K. M. Laing, R. C. Turnbull. Standing, left to right: J. R. Johnson, J. F. White, J. R. Hensler, J. C. Richmond.

SYMPOSIUM ON RADIOCERAMICS

The first symposium on radioceramics, co-sponsored by the Ceramic Association of New Jersey and the School of Ceramics, Rutgers University, was held in New Brunswick, New Jersey, on January 13, 1954. Approximately 200 attended. The symposium was devoted to the effect of radiations on ceramics materials, nuclear applications of them, and also the use of radioisotopes in ceramic research. Dr. J. Vincent Fitzgerald, School of Ceramics, Rutgers University, acted as chairman.

J. F. White, of the United States Atomic Energy Commission, gave the introductory talk entitled "Review of Effect of Irradiations on Ceramic Materials and the Requirements for their Nuclear Reactor Use", discussing the various phases to be covered in the symposium. The other speakers and their topics included: "Fundamental Approaches to the Glassy State through Radioactive Tracers", Henry H. Blau, Department of Ceramic Engineering, The Ohio State University; "Applications of Radioactive Isotopes to Glass Technology", S. Frank Cox, Glass Division, Research Laboratories, Pittsburgh Plate Glass Company, (paper presented by K. M. Laing); "Some Effects of X and Gamma Radiation on Glass", Norbert J. Kreidl, Bausch and Lomb Optical Company, (paper presented by J. R. Hensler); "Diffusion Studies Using Radioactive Isotopes", Robert C. Turnbull, New York State College of Ceramics, Alfred University; "Radioisotope Studies of Porcelain Enamel Adherence", J. C. Richmond, National Bureau of Standards; "Ceramics for Nuclear Reactor Applications", James R. Johnson, Oak Ridge National Laboratory, Carbide and Carbon Chemicals Company; "Flow of Heat Through Porous Solids", F. H. Norton, Massachusetts Institute of Technology.

B. B. GALASI DIES

Bela B. Galasi, Circulation Manager for The Glass Industry since 1948, died on January 23 in New York City at the age of 51. He had been ill for several months.

Before joining Ogden Publishing Company, Mr. Galasi had worked with E. W. Williams publications and the *New York Herald Tribune*.

He joined the Boy Scouts at the age of 15 and maintained an unbroken record of work with them up to the time of his death. He became a district commissioner in 1930, and was awarded the Silver Beaver, highest order a local chapter can confer, in 1933.

HARLAN LOGAN NAMED PRESS SERVICE CHIEF

Former magazine editor Harlan Logan has been named Chief of the International Press Service of the U. S. Information Agency, Theodore C. Streibert, Director of the agency, has announced.

Mr. Logan was Editor and Publisher of Scribner's Magazine from 1936 to 1939 and Editor and General Manager of Look Magazine from 1940 through 1946. He owned and managed Visual Enterprises, Inc., from 1937 to 1952. He has most recently served as Director of Public Relations for Corning Glass Works and Steuben Glass, Inc., from which he resigned to take over his new government assignment.

PENNSALT CONSOLIDATES PERSONNEL AND PUBLIC RELATIONS

George B. Beitzel, President of the Pennsylvania Salt Manufacturing Company, has announced the consolidation of its personnel and public relations activities under the direction of Fred C. Abbott, Manager of Personnel and Labor Relations since 1947. The redesignated office will be known as the office of Industrial Relations.

Mr. Abbott, a chemical engineer, was graduated from the University of Arkansas and joined Pennsalt in 1943. He attended the advanced management course of Harvard Graduate School of Business Administration in 1950. His staff will serve nine plants and numerous sales offices of the parent company and its three subsidiaries.

Concurrently, Dr. W. Austin Bishop, Director of Training and Employee Publications, was named Manager of Public Relations. He will succeed Cleveland Lane, who recently resigned to accept a similar position with the Manufacturing Chemists' Association. Dr. Bishop joined Pennsalt in 1950, following a three-year public relations assignment in Department of Army Headquarters.

CAMBRIDGE WIRE CLOTH ADDS TO STAFF

The Cambridge Wire Cloth Company has announced the appointment of Richard C. Carmean to its sales engineering staff.

Mr. Carmean will assist Fred L. Stevenson in sales and service work in the Ohio-Michigan-Eastern Indiana territory. The new appointment will provide this important industrial area with broader direct factory service on the products manufactured by Cambridge.

• Dr. Roger Adams, internationally known chemist and educator, has accepted an appointment to the Board of Trustees of Battelle Memorial Institute. Dr. Adams, head of the University of Illinois' Department of Chemistry and Chemical Engineering, has achieved wide recognition, especially for his research on stereochemistry and natural products.

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during November 1953 was as follows: *Flat Glass:* A preliminary 31,600 was reported for November employment. This is only .3 per cent below the adjusted October figure of 31,700. *Glass and Glassware, Pressed and Blown:* A preliminary figure of 90,800 persons is given, which represents a drop of .5 per cent from the adjusted 91,300 reported for October. *Glass Products Made of Purchased Glass:* For the month of November, a preliminary employment figure of 13,700 is reported. This is 4.1 per cent below the adjusted October figure of 14,300.

Payrolls during November 1953 were: *Flat Glass:* A preliminary $13,486,564 payroll figure was reported for November. Compared with the adjusted October figure of $13,174,837, an increase of 2.1 per cent is indicated. *Glass and Glassware, Pressed and Blown:* For November, a preliminary $27,593,817 is shown, indicating an increase of 9.6 per cent over the previous month's adjusted $27,330,351. *Glass Products Made of Purchased Glass:* A preliminary $3,637,395 is shown for November. Compared with the previous month's adjusted figure of $3,781,825, a drop of 3.8 per cent is indicated.

GLASS CONTAINER SHIPMENTS
(All Figures in Gross)

	December, 1953
Narrow Neck Containers	
Foods	727,143
Medicinal & Health Supplies	1,025,637
Chemicals, Household & Industrial	528,002
Beverages, Returnable	1,089,290
Beverages, Non-returnable	48,891
Beer, Returnable	226,771
Beer, Non-returnable	476,520
Liquors	604,349
Wines	363,340
Toiletries & Cosmetics	490,341
Sub-total (Narrow)	5,634,284
Wide Mouth Containers	
Foods	*2,511,077
Dairy Products	416,968
Medicinal & Health Supplies	342,222
Chemicals, Household & Industrial	112,344
Toiletries & Cosmetics	143,101
Packers' Tumblers	131,474
Sub-total (Wide)	3,657,186
Total Domestic	9,291,470
Export Shipments	224,669
TOTAL SHIPMENTS	9,516,139

* This figure includes Home Canning.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All Figures in Gross)

		Production December 1953	Stocks December 1953
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	5,492,400	6,777,604
	Wide Mouth	*3,396,748	*3,905,378
Dairy Products		318,951	221,753
Beverages, Returnable		809,619	774,782
Beverages, Non-returnable		43,308	126,573
Beer, Returnable		262,487	218,876
Beer, Non-returnable		458,747	597,013
Liquors		678,382	910,348
Wines		336,574	335,063
Packers' Tumblers		140,014	217,790
TOTAL		8,889,148	10,682,982

* This figure includes Home Canning.

Glass container production, based on figures released by the Bureau of Census, continued downward during December 1953 to reach 8,889,148 gross. This is a drop of 7.6 per cent from the previous month's 9,621,935 gross. During December 1952, production was 8,250,347 gross, which is 7.7 per cent below December 1953. At the end of 1953, glass container production had reached a total of 123,021,081 gross, the largest number of glass containers ever produced during a single year. Compared with 1952 production, which was 115,631,318 gross, a rise of 6.3 per cent is shown for 1953 over 1952.

Shipments of glass containers during the last month of 1953 were 9,516,139 gross. This is a 4 per cent increase over the previous month's shipments, which were 9,150,038 gross. During December 1952, shipments were 8,115,977 gross, or 17.2 per cent less than for December 1953.

Shipments of glass containers during 1953 have established a new record for sales during a single year. These shipments totaled 121,351,249 gross. Compared with the previous high of 116,002,796 gross, which were shipped during the year 1946 when wartime tin shortages forced many firms to turn to glass as a packaging medium, the new high is significant in that no emergency stimulus was responsible for sending glass container usage to such high levels. Total shipments during 1952 were 114,144,927 gross, which shows a 1953 gain of 6.3 per cent.

Stocks on hand at the end of December 1953 were 10,682,982 gross, which is 6.1 per cent below November stocks of 11,388,384 gross, and 5 per cent higher than the 10,166,279 gross on hand at the end of December 1952.

Automatic tumbler production during November 1953 was 4,635,099 dozens. This is a drop of 14.9 per cent from October production of 5,449,722 dozens. During November 1952, stocks were 5,190,508 dozens. Shipments during November 1953 were 3,986,370 dozens, which represents a drop of 30.2 per cent from the 5,716,071 dozens shipped during October. Shipments during November 1952 were 4,693,424 dozens. Stocks on hand at the end of November were 10,715,680 dozens. Compared with the 10,266,894 dozens on hand at the end of October, a rise of 4.3 per cent is shown. Stocks at the close of November 1952 were 8,430,566 dozens.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and house-

(*Continued on page* 106)

New Equipment and Supplies

GLASS LATHE

Bethlehem Apparatus Company, Inc., Hellertown, Pa., has developed a new type of glass lathe, designed for specialized glass work in the laboratory and certain types of production operations. It can be used to make ring seals, tees, flanges, tapers, glass fusings, closures and a variety of repairs.

A sleeve-grip chuck permits quick set-ups of practically all forms of glass work without elaborate accessories. Tubing of any length up to 100 mm. diameter can be mounted through the spindle. Extension bars grip a variety of glass shapes in sizes up to 12" diameter with eccentric settings made as required. The unit can be adapted for use as a vertical lathe. Extra accessories are not needed for the lathe except for special purposes or where large scale production of identical parts is desired.

The apparatus is constructed for exact and permanent centering, and for greatest possible operating convenience. The floating tailstock with finger-tip control eliminates backlash and is detachable when large pieces are worked on the headstock. It is provided with an automatic brake, floating burner carriage, non-warping bed, pinion-bar drive the full length and a 1/12 H.P., A.C. 115-volt motor mounted on the lathe bed. Normal chuck speed is 32 R.P.M.

SAFETY SPECTACLES

Watchemoket Optical Company, Inc., 232 W. Exchange Street, Providence, Rhode Island, has announced new shatterproof, multi-purpose safety spectacles, called "Visor-Tuc" Eye Savers, which give almost 100% protection from eye injuries and weigh hardly more than an ounce.

Over-eyes protection from glare and flying particles is provided by the built-in visor, an extension of the frame, shaped to fit snugly against the wearer's forehead. Injury from side or bottom is prevented by "semi-cup" lenses, so called because of lens-flanges extending from the lenses toward the cheek. Made in a single frame style that fits all workers, this feature is made possible by a "Universal" nosepiece which rests lightly on the nose and by "Retrax Temples" which can be adjusted instantly by each wearer to suit the shape of his face. Shatterproof, methacrylate lenses can be replaced in an instant—easily removed and inserted by the wearer yet securely locked in place. Lenses are optically correct to prevent eye strain and permanent injury resulting from distortion of the image.

GLASSWARE WASHER

Fisher Scientific Company, 717 Forbes Street, Pittsburgh 19, Pa., has made available an improved Fisher Charlab Washer with a new series of glassware baskets to extend the washer's versatility. According to the company, the new washer can handle everything from over-size graduates to micro pipettes. This includes large, odd-shaped funnels and flasks that are not usually handled by mechanical washers.

Large pieces of glass are locked directly in place with the Charlab's screens-and-rods combination. Smaller or special pieces—test tubes, syringes, microscope slides, Petri dishes—go into the new accessory baskets which are attached to the carrier discs with rods.

The revolving discs dip the loaded baskets and screens-and-rods combinations into the hot wash water, each piece of glassware fills with hot cleaning solution, soaks, and empties again as the wheel goes around. Feature of the washer is the turbulent flow of hot wash water into, around and out of the glassware. Another major feature is its capacity. Although it needs only 20 x 40 inches of floor space, it accommodates in one load some 1300 test tubes plus 60 Petri dishes.

CATALOGS RECEIVED

Aluminum Company of America, Chemicals Division, Alcoa Building, Pittsburgh 19, Pa., has compiled and issued an interesting and attractive booklet devoted to the history of ceramics.

Entitled "Ceramics and Man Through the Ages", the booklet is comprised of advertisements run by the company in various business publications. Each subject is illustrated in color, with a brief history of its origin. Also given is the chemical analysis of each.

Wirebound Box Manufacturers Association, 327 S. LaSalle Street, Chicago 4, Illinois, has published a revised edition of the brochure, "What to Expect from Wirebounds".

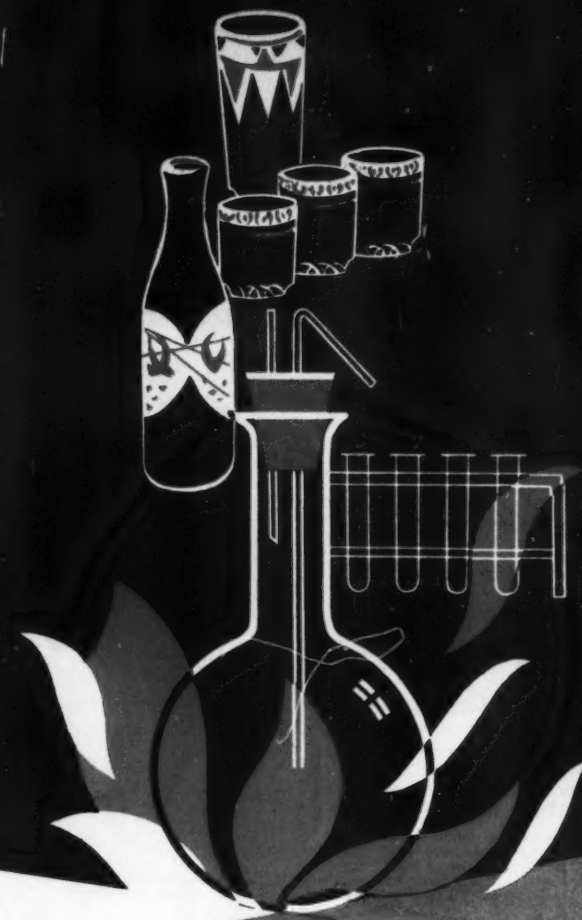
The new edition is profusely illustrated with actual "case history" pictures of wirebound boxes, crates and pallet boxes in use. It covers the construction principles of wirebound shipping containers, the four basic styles of wirebound boxes, typical wirebound pallet boxes for materials handling needs, and how wirebound boxes and crates result in reduced tare weight, quicker packing, easier stacking, reduction of space in storage after being packed and generally over-all lower packing costs.

Foxboro Company, Foxboro, Mass., has issued a new edition of its 36-page bulletin, "Thermocouples and Accessories".

Listed with specifications are standard thermocouples for all applicable temperature ranges. Separate sections are devoted to the tubular-type iron-constantan couples, wire-type iron- constantan and copper-constantan couples, and Chromel-Alumel alloy and platinum couples.

Generously illustrated, the bulletin contains dimensional drawings of complete assemblies. Ten installation diagrams are helpful in determining types of thermocouples needed for various furnaces, tanks, kilns, and pipe lines. In addition to complete parts lists for each type, there are catalogued sections devoted to couple supplies and accessories, such as connection heads, protection tubes, Flintex porcelain insulators, sheaths, stuffing boxes, extension wire and bulk thermocouple wire.

Minneapolis-Honeywell Regulator Company, Industrial Division, Wayne and Windrim Avenues, Philadelphia 44, Pa., has issued Instrumentation Data Sheet No. 6.4-11, describing instrumentation for measurement and control of temperatures during heat-up of open hearths, glass tanks and other high-temperature furnaces.



HOT OIL COLORS . . .

You get Proved Plant Performance with PEMCO Hot Oil Colors

Hot oil colors harden instantaneously on contact. A second color can be added with no loss of time. Hot oil colors give you versatility, in complete wrap-around designs.

PEMCO Hot Oil Colors are *smooth*, leave little or no screen mark. Many glass decorating plants have used them successfully for over two years.

Our Pemco sales-engineer will be happy to discuss the use of hot oil colors in your operations. Just drop us a line.

WORLD'S FINEST PEMCO

PEMCO CORPORATION **BALTIMORE 24, MD.**

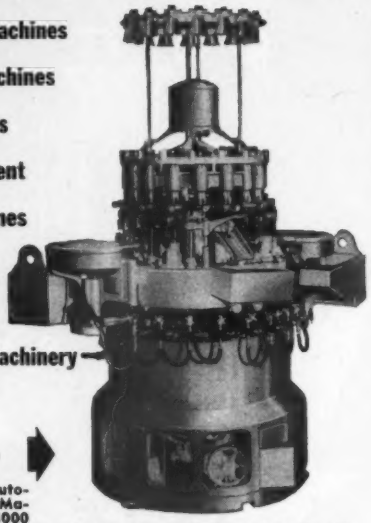
Vitrifiable Glass Colors • Screening Pastes • Satin-Etch
Porcelain Enamel Frits • Glaze Frits • Stains • Colors

Keep your production of Incandescent Lamps, Fluorescent and Electronic Tubes at its peak with

STANDARD TOOL

Automatic Glass Machines . .

★ Hot Cut Flare Machines
★ Cold Cut-off Machines
★ Sealing Machines
★ Exhaust Equipment
★ Finishing Machines
★ Glass Lathes
★ Stem Machines
★ Special Glass Machinery



Illustrated at right—Automatic Hot Cut Flare Machine with capacity of 3000 to 4000 pieces per hour. Universal upper chucks accommodate No. 27 to No. 44 tubing. Micrometer adjustments for cutter and flaring tool.

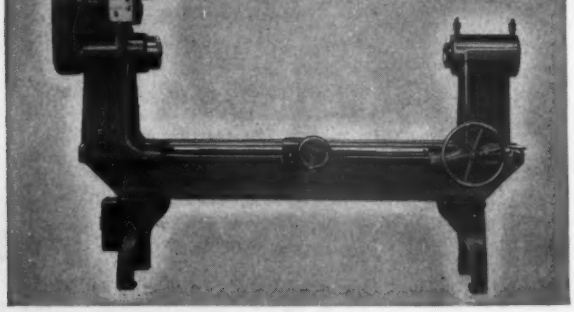
● Standard Tool engineers are specialists in the design and manufacture of automatic machines for all types of incandescent lamps, fluorescent, electronic and cathode ray tubes. Over 40 years experience in the glass field, plus precision manufacturing refinements assure you of equipment that will exceed your production expectations. A competent engineering staff is available for consultation at your convenience. Standard Tool machines have been production-proven over many years!

Creative Machine Designers & Builders

STANDARD TOOL & MANUFACTURING CO.

235 LAUREL AVENUE
ARLINGTON, NEW JERSEY

Illustrated below—5" Spindle Glass Lathe designed for television tube production —— 73" maximum distance spindle to spindle and 44" diameter swing. Has high ratio spindle length to spindle diameter and tapered spindle bearings. Incorporates hand scraped ways and integral variable speed drive.



NEW O-C STRIA ACOUSTICAL TILE

A new product, non-combustible Stria Acoustical Tile, which affords many decorative possibilities in ceiling design, has been announced by Owens-Corning Fiberglas Corporation.

The new tile face presents multiple striations or grooves permitting great variety in ceiling patterns. The surface of the tile reflects more than 75 per cent of light striking it and affords installation in numerous decorative patterns. Available in 12" x 12" and 12" x 24" sizes, Stria has a noise reduction coefficient up to 80 per cent.

The tile is composed of fine fibers of glass compressed into boards which contain countless tiny air cells. Sound waves are trapped in the highly porous surface. The tile may be spray painted as many as eight times with a non-bridging water-base paint without affecting its noise reduction efficiency.

CONSOLIDATED FELDSPAR EXECUTIVE CHANGES

R. W. Lawson, General Manager of the Consolidated Feldspar Department of the Industrial Minerals Division of International Minerals & Chemical Corporation, has been appointed administrative assistant to Norman J. Dunbeck, Vice President in charge of the division.

While Mr. Lawson's responsibilities will become more limited in his new capacity, he will continue to serve the Industrial Minerals Division on special assignments. He has spent 40 years in the feldspar business and played a major part in building Consolidated Feldspar Corporation, which was acquired by International in 1952.

The appointment of E. W. Koenig as General Manager of the Consolidated Feldspar Department to succeed Mr. Lawson was also announced by Mr. Dunbeck. Mr. Koenig has been Technical Director of the department and has been associated with Consolidated in various capacities for 24 years.

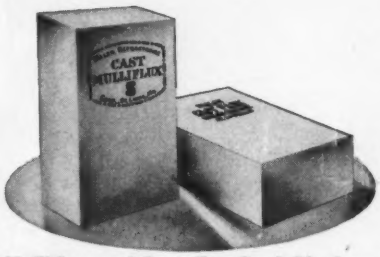
• Among the distinguished foreign scientists invited by the Government of India to be its guest at the Indian Science Congress was Emeritus Professor W. E. S. Turner. After the Congress, Dr. Turner is due to visit and lecture at a number of University and research institutions.

HOW TO GET MORE FOR YOUR REFRACTORY DOLLAR

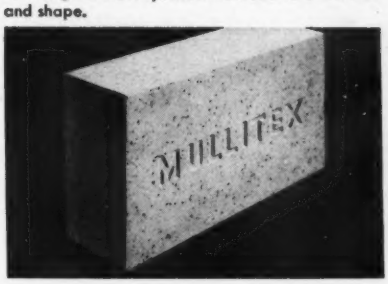
SOLVED

with WALSH MISSOURI-QUALITY REFRACTORIES

Meeting today's demands for greater production at lower cost calls for refractories that yield maximum service and economy. Each time-tested Walsh product is a supreme achievement—the result of unique properties, advanced methods of manufacture and better research and ceramic engineering—a combination that sets new standards for long life and dependability. These factors mean longer furnace lining life with less down-time for repairs, reduced manufacturing costs and, consequently, *more for your money*.



Mulliflux and Cast-Flux Tank Blocks—Greater density, more uniform expansion and superior resistance to high temperatures and corrosion characterize Walsh vacuum cast tank blocks for the glass industry. Machine-trued to exact size and shape.



Mullitex Fire Brick—Super duty. Dry press process. Tunnel kiln burned.

Mullitex HB (High Burn) special super duty. (D.P.) Tunnel kiln burned. 100% Missouri clays.

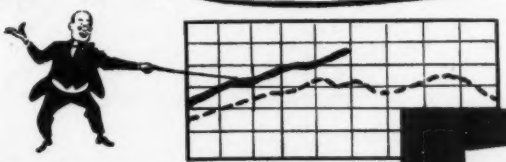
CSR—For safer, longer lasting protection in glass tank upperstructures.

CSR (Fortified). For extra life in upperstructures "tough spots". P .C. E. Cone 39 (3389 deg. F.)

Feeder Parts—Use WALSH (Vacuum-Cast) Channels, Spouts, Tubes, Plungers, and other Forehearth Shapes for longer life, better quality glass, and complete service satisfaction.

WHAT'S YOUR PROBLEM?

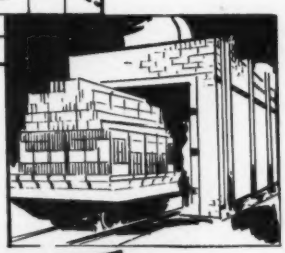
If you have an unusual refractory problem, if you have difficulty in reaching and maintaining desired service life, if you have *any* refractory problem at all, it will pay you to investigate the outstanding properties of Walsh Refractories. Your inquiries are invited. No obligation, of course.



PROGRESS REPORT

What Walsh Is Doing To Increase Refractory Production

Completion this year of a large, new tunnel kiln at our Vandalia, Missouri works will help meet the great and growing demand for quality fire clay refractories needed both for defense and civilian requirements. This project is another example of ... progress at Walsh ... for over 50 years manufacturers of high grade refractories.



WALSH ALSO MAKES:

High Heat Duty Fire Brick • Plastic Furnace Lining • High Temperature Cements • Air Setting Castables • Insulating Cements • Plastic Ramming Mix • Wall Coatings • Special Shapes ... and a complete line of Refractories for the Glass Industry.

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FOR OVER 50 YEARS MANUFACTURERS OF HIGH GRADE REFRACTORIES

FACT: *in grinding glass* — metal bonded diamond wheels grind faster, at lower cost and with less spoilage than any other known method.

FACT: *in grinding carbides* — nothing cuts as fast, as cool and as economically as a diamond wheel.

FACT: *in dressing grinding wheels* only diamond dressers will do the job where fine finish, high production or intricate forms are involved.

FACT: *in lapping* — diamond compounds and powders save countless skilled man-hours by producing wanted sizes and finishes faster.

FACT: *in cutting* — diamond cutting and boring tools are standard for tough jobs where the best of competitive materials fail.

FACT: *in sawing* — diamond saw blades feature speed and economy on quartz, concrete, stone, sapphire, glass and diamond.

FACT: **Diamond Tooling gives you precise production, more production, uninterrupted production, *lowest cost production.***

IT IS A FACT . . . THERE IS NO ECONOMIC SUBSTITUTE FOR DIAMONDS

News Note: there is not a shortage of industrial diamonds. Learn the detailed facts about this wonder material. Write today for specific information and free booklet, "The Diamond That Pays For Itself."

INDUSTRIAL DIAMOND ASSOCIATION OF AMERICA, Inc.

124 East 40th Street, New York 16, N. Y.

FORTER-TEICHMANN OFFICER CHANGES

At a recent meeting of the Board of Directors of Forter-Teichmann Company, S. A. Forter was elected Chairman of the Board, H. A. Roth as President, and John J. Timberlake as Executive Vice President. Mr. Timberlake continues to hold his previous office of Secretary-Treasurer and Rosemary Beck, an employee of many years service, was elected as Assistant Secretary.

Mr. Forter, who has been in the glass engineering business for thirty-five years, continues his association with the company in an advisory and consulting capacity.

DR. HERBERT INSLEY RETIRES FROM NBS

Dr. Herbert Insley, Chief of the Mineral Products Division of the National Bureau of Standards, holder of the Ross Coffin Purdy Award of the American Ceramic Society and a pioneer in the application of petrographic microscopy to ceramic problems, has retired from NBS. Dr. Insley will remain in Washington after retirement and do consulting work.

Dr. Insley is internationally known for his researches in the microstructure and chemistry of mineral products. He has specialized in petrography, X-ray diffraction techniques, and electron microscopy of inorganic and non-metallic minerals and is the author of a large number of technical papers in his field. Publication of the book, "Phase Diagram for Ceramists", co-authored by Dr. Insley and Dr. F. P. Hall, resulted in the two men being chosen as the first recipients of the Ross Coffin Purdy Award.

Before he became Chief of the Bureau's Mineral Products Division in 1947, Dr. Insley was Chief of the Constitution and Microstructure Section and Assistant Chief of the Mineral Products Division. He was Head of the Pennsylvania State College Department of Earth Sciences from 1944 to 1945, having been a petrographer with the National Bureau of Standards from 1922 until 1944. Between 1921 and 1922, Dr. Insley was with the U. S. Bureau of Mines, working on the petrography of mine dusts.

FERRO HONORS EMPLOYEES

The annual Bob Weaver Award of Ferro Corporation was presented to four of Ferro's personnel at a recent dinner. Presentation of the awards was made by Robert A. Weaver, Chairman of the Board of Ferro, for whom the award is named.

Established in 1947, the award is given annually to the employees who have made the greatest contribution to Ferro's advancement during the year. The award consists of a cash consideration and a certificate.

Named as this year's winners are Russell W. Frank, Safety Director, for contributing to an outstaindings safety record in all divisions of Ferro Corporation; Russell A. Whiteman, Chief Process Engineer, Tuttle & Kift, Inc., for reducing scrap and rework at this Ferro subsidiary; Bernard A. McDermott, Ferro Plant Manager at Nashville, for his outstanding contribution to the reorganization of Ferro Powdered Metals, Inc.; Edward J. Riley, Foreman of the Stabilizing Department of Ferro Chemical Corporation at Bedford, Ohio, for substantially raising production and quality standards at his division.

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INVENTIONS AND INVENTORS . . .
(*Continued from page* 86)

The patent contains ten claims and the following references were cited: 1,409,888, Taylor, Mar. 14, 1922; 1,618,085, Hess, Feb. 15, 1927; 1,800,743, Morris, Apr. 14, 1931; 2,041,642, Griffin, May 19, 1936; 2,178,504, Waldron et al., Oct. 31, 1939; and 2,309,819, Benner, Feb. 2, 1943.

Tube and Cane Machines

Reinforced Glass Fiber Tubing. Fig. 7. Patent No. 2, 653,887. Filed August 1, 1947. Issued September 29, 1953. Two sheets of drawings. Assigned to Owens-Corning Fiberglas Corporation by Games Slayter.

This invention is related to the fabrication of plastic tubing or pipe having walls reinforced with fibrous materials, such, for example, as layers constituted essentially of glass fibers. The walls are reinforced by layers of fibrous materials having substantially no tendency to delaminate and which may be constructed to range from a porous wall for irrigation purposes to a completely impervious wall for use in the transportation of fluids.

Plastic tubing is formed as shown in Fig. 7 by helically winding strips 10 of resinous treated fabrics in side-by-side or overlapping relation on a mandrel 11 and then subjecting the whole to resinous curing conditions to form a composite tubing 12 that may be stripped from the mandrel. Three layers, a, b and c, of resinous treated fabric make up the side wall construction of the tubing, but the number of layers or plies may equally be varied from one layer up to twenty layers or more, depending on the strength, wall thickness and properties desired of the tubing. Alternatively, the fibrous fabric may be wound as desired on the mandrel, and between each layer, sufficient resinous material is added by various known means, such as by brushing, spraying, flow coating or by forming alternate layers of a resinous material in sheet form and the like, to effect the desired bonding relation and imperviousness. Resinous materials suitable for binding include a wide variety of phenols, organo-silicons and vinyl polymers.

The patent contains two claims and 19 references were cited.

Miscellaneous Processes

Sealing Apparatus. Fig. 8. Patent No. 2,654,181. Filed November 15, 1949. Issued October 6, 1953. Three sheets of drawings. Assigned to Radio Corporation of America by Andrew L. Lucarelli.

An improved apparatus for making relatively large size glass-to-metal work pieces is shown in Fig. 8. It is especially adapted to the manufacture of cathode ray tubes in which a glass face plate is sealed to a large metal cone.

In operation, timer 51, which may be set to operate in a predetermined intermittent manner, actuates solenoid 50 to open valve 49a to a source of air pressure. Air under pressure enters power transfer device 49 to cause the diaphragm 74 of the latter to flex to the left. This flexing movement of the diaphragm will be transmitted through link 45 to lever 30a causing the latter to rotate in a clockwise direction. This rotation of the lever results in rotation of the burner assembly to a position above the work pieces 13. This rotation of lever 30a also causes rotation of shaft 32 and the levers 77, 78 fixed

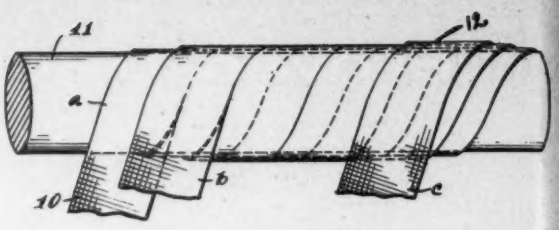


Fig. 7.

thereto. Rotation of lever 77 in a clockwise direction causes it to trip switch 52 to close the circuit actuating the turret 10 in intermittent movement. Rotation of lever 78 releases pressures on lever arm 79 causing lever arm 80 to release pressure on the economizer valves 41, 42, 43.

A similar lever 78a (not shown) causes the fuel flow to the burners to be shut off. At the end of the interval started by raising the burner above the work pieces, the timer 51 will cause solenoid 50 to close the valve 49a to the air supply and open communication with a vacuum chamber. This will cause the power transfer unit 49 to move link 45 to the right resulting in counter-clockwise rotation of the burner unit and a lowering to a position around the work piece 13. This causes lever 77 to release its pressure on switch 52 resulting in an opening of switch 52 and a positive stoppage of further actuation of turret 10.

The patent contains eight claims and fifteen references were cited.

Refractory Furnace Roof Brick Resistant to Spalling. Patent No. 2,652,793. Filed October 30, 1948. Issued September 22, 1953. Six sheets of drawings (none reproduced). Assigned to General Refractories Company by Russell P. Heuer and Mervin A. Fay.

This invention relates to the manufacture of brick having unusually high resistance to spalling and particularly to such brick intended for use in suspended roofs or supported wall construction of furnaces. Basic refractory brick are molded under high forming pressure and concurrently with the molding an oxidizable metallic spacer effectively subdivides the brick internally in a direction which will resist spalling. The spacer also provides a means of support by which the refractory may be hung or supported.

The patent contains five claims and the following references were cited: 2,187,669, Stewart, Jan. 16, 1940; 2,247,376, Heuer, July 1, 1941; and 2,465,170, Rochow, Mar. 22, 1949.

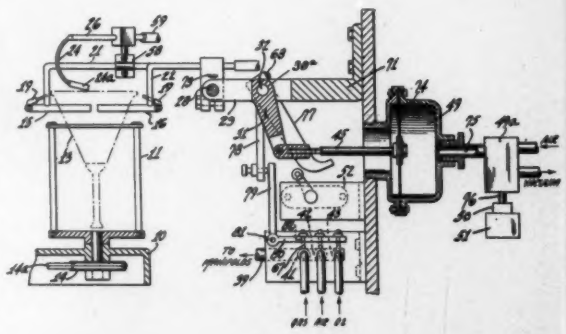
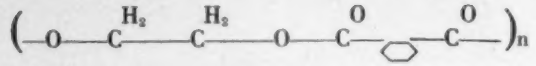


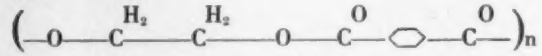
Fig. 8.

the world

(*Continued from page* 72)

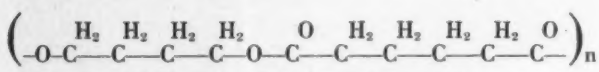


is not crystalline, whereas that of glycol and of p-phthalic acid

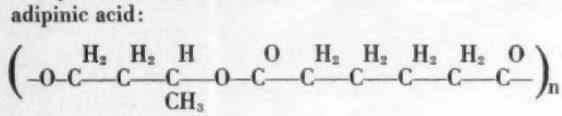


is.

The condensation product of butanodiol — 1.4 and adipinic acid:

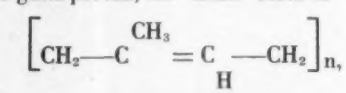


is crystalline, whereas that of butanodiol —1,3 and of adipinic acid:



is not.

Thus also gutta-percha, the "trans" form of

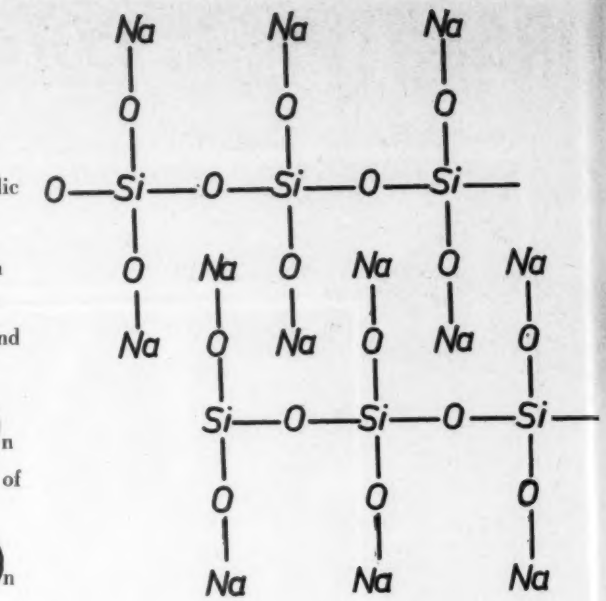


is crystalline, whereas rubber, the "cis" form of the same figuration, is not.*

We are inclined to believe that something similar occurs in the SO_3 and PO_3 chains in the glasses we have been considering.

If we construct the configuration (in a simplified but representative form, see Fig. 7) by adding the necessary positive ions to ensure that the whole will be electrically neutral, we immediately see the analogy with the organic examples already given.

The difference in behavior of the silicates and phosphates when Y is less than 2 may be interpreted in the following manner: The chains in silicate glasses are highly symmetrical and crystallize notwithstanding their length; the chains in phosphate glasses are not symmetrical and thus always yield vitreous products.



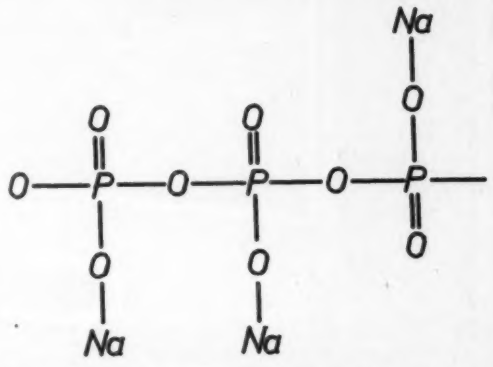


Fig. 7. Schematic representation of SiO_3 and PO_3 chains.

However, when Ca^{++} or Ba^{++} ions are added to sodium or potassium silicates, glass is still formed in a certain range where Y is less than 2.[8,10] The cause of this lies as much in the disturbance in the symmetry as in the formation of sturdy bridges between the chains. It is possible that the formation concerned considerably hinders the slippage and, therefore, prevents the crystallization, while encouraging the actual formation of glass.

It is remarkable that even the mixed sodium-potassium silicates[9] already become vitreous when the Y values are below the limit of $Y = 2$ mentioned. This shows that a slight disturbance in the symmetry is apparently all that is necessary in this case to counteract the crystallization.

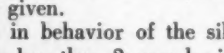
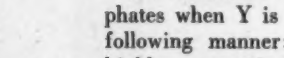
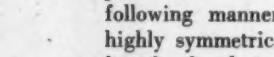
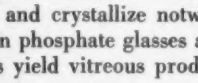
Let us now consider the range where Y is less than 2. This will imply that the chains are no longer infinitely long but that they are of limited length, at least for so far as we do not include annular forms. In the case of sodium phosphate glass, vitrification goes on until Y is equal to 1.6.[9] **

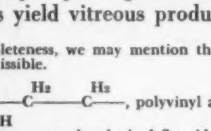
If in general in this range the chains include an average of q tetrahedrons, the following relation holds:

$$Y = \frac{2q - 2}{q} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

(*Continued on page* 102)

* For the sake of completeness, we may mention that small disturbances in the symmetry are permissible.

Thus polythene  , polyvinyl alcohol  and polyvinyl fluoride  are crystalline (the F atoms and OH groups are hidden as it were *in* the chains, although their locations are irregular), whereas polyvinyl chloride: 

and polyvinyl acetate: 

are not crystalline.

** Recent experience has shown that practically the same limit exists for baryum and calcium phosphates. It is a remarkable fact, however, that as far as lithium, beryllium, lead, zinc and magnesium phospates are concerned, this limit is transferred to compositions having more molecule-grammes of P_2O_5 and fewer molecule-grammes of metallic oxide; the ions in question either form sturdy bridges (Li^+, Be^{++}), or partly occupy the network-forming positions (Pb^{++}, Zn^{++} Mg^{++}), in such a way that the actual value of Y is greater than that which is calculated direct on the basis of the composition.

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GLASS AS A POLYMER . . .
(*Continued from page* 100)

This implies that the sodium phosphate, etc., do not become vitreous if the average chain length is 5 tetrahedrons or less. Without any suggestion that there is a quantitative relationship, it is interesting to recall the above example of the polymer of p-cresol and formaldehyde to note the striking analogy.

(*To Be Continued*)

WYANDOTTE APPOINTMENTS

Herbert S. Shultz has been recently appointed industrial engineer at Wyandotte Chemicals Corporation. A veteran of 13 years with Wyandotte, Mr. Schultz has been a member of the technical service department of the Michigan Alkali Division since 1948. In his new position, he will act in the capacity of a technical service representative to Wyandotte's manufacturing division.

Recently appointed a technical service representative of the Michigan Alkali Division of Wyandotte is Lawrence J. Healy, Jr. Mr. Healy joined Wyandotte's research division in 1948 and was section head of the fine chemicals department in the pilot plant prior to his new appointment.

• Norton Company has announced the appointment of Jack M. Esten as Abrasive Engineer and Robert C. Divoll as a Field Engineer. Both are recent graduates of the sales training course.

TOLEDO ENGINERING MOVES TO NEW LOCATION

Announcement has been made of the removal of the offices of Toledo Engineering Company to 3001 Sylvania Avenue, Toledo 13, Ohio. The telephone number is Klondike 1529.

NO-RAIDING AGREEMENT BETWEEN UNIONS

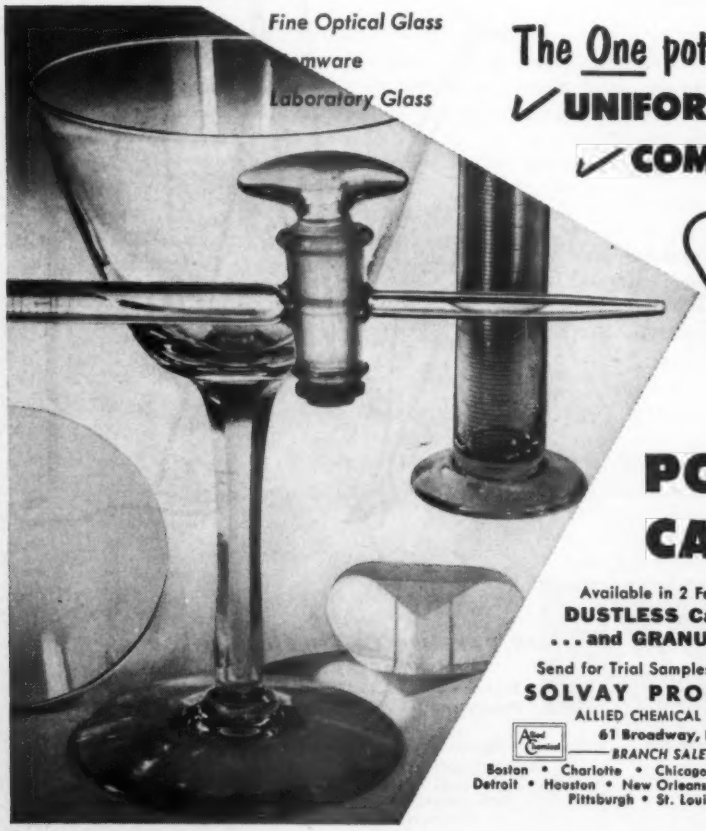
The Executive Board of the Glass Bottle Blowers Association, AFL, at its winter meeting unanimously ratified the no-raiding agreement between the AFL and the CIO, it was announced by Lee W. Minton, International President. The agreement, signed by Mr. Minton and Secretary Newton W. Black, was turned over to George Meany, President of the AFL.

In the past, there have been some jurisdictional disputes with the CIO Glass, Ceramic and Silica Sand Union. It is believed the pact will eliminate raiding by either union.

CARBORUNDUM ELECTS VICE PRESIDENT

W. J. Ulrich, The Carborundum Company's senior sales representative in the Detroit area, was elected Vice President of the company, according to F. J. Tone, Jr. Vice President and a Director of the company.

Mr. Ulrich will continue his sales activities in the Detroit area, but will report to the Vice President of Sales in Niagara Falls, New York.



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RUSSIAN TRANSLATIONS . . .
(*Continued from page* 80)

is pulled (to the right in the front view and the top view of Fig. 1) by 8, the cutter moves along the glass sheet at the level of 13 (see the side view of Fig. 1) and makes a scratch.

The movement of the cutter is stopped by buffer 4. The impact of the cutter on 4 closes contact k which activates electromagnet M. This magnet lifts relay and thus interrupts the current in electromagnet u. Pulley 8 is thus released and drops off the axle of motor 9. The rope then unwinds under the action of weight moving in cylinder 7, and thus restores cutter 3 to its initial position next to buffer 5. 2 is the rail along which cutter 4 is pulled by the rope. 6 is the other weight keeping the rope in tension. (The first weight is suspended in cylinder 7.) 12 are rollers guiding the glass sheet.

WAVINESS OF RUSSIAN THREE-LAYER SAFETY GLASS

N. I. Amosov and M. R. Savitskii report, in *Steklo i Keramika* (Glass and Ceramics) **9**, No. 7, 14 (1952), some measurements of the waviness of commercial safety glass whose middle layer consisted of cellulose nitrate or vinyl butyral.

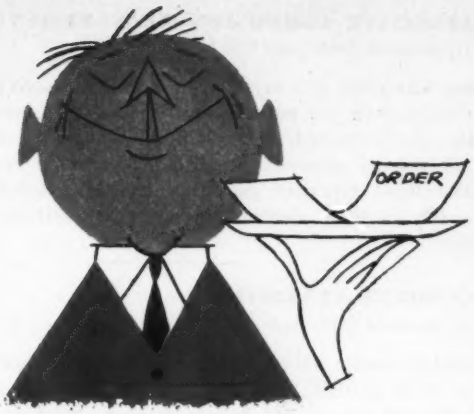
The waviness was defined as the greatest deviation (in minutes of a degree) which occurs in a light beam traversing the glass pane under test. Among 100 panes tested, 3 had a deviation of 2′, 14 a deviation of 3′, 23 of 4′, 25 of 5′, 15 of 6′, 11 of 7′, 5 of 8′, 3 of 9′, and one of 10′.

VISCOSITY OF SODIUM-CALCIUM-ALUMINUM SILICATE GLASSES

M. V. Okhotin and R. I. Tsoi, in *Steklo i Keramika* (Glass and Ceramics) **9**, No. 8, p. 3 (1952), give the following values for the viscosity η of several glasses determined by the rate of extension of glass rods loaded with a glass blob.

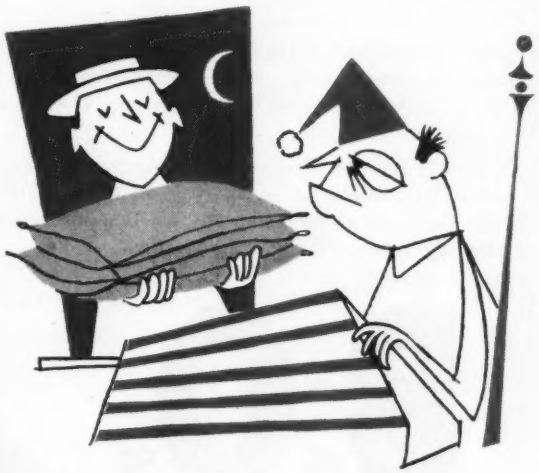
No.	Chemical Composition Na_2O	CaO	MgO	Al_2O_3	SiO_2	Temp.°C.	Log η (poises)
8	16.49	4.9	2.94	1.02	74.26	772	6.42
						732	7.05
						709	7.50
						670	8.22
13	16.5	5.24	2.98	2.96	72.53	771	6.59
						736	7.18
						702	7.80
						670	8.48
32			approximately			792	6.40
	16	5	3	5	71	765	6.80
						726	7.43
						709	7.80
						670	8.60
7	16.26	7.57	3.15	1.35	71.68	760	6.59
						739	7.00
						704	7.71
						669	8.41
18	16.15	7.22	3.02	3.11	70.57	784	6.46
						765	6.74
						728	7.37
						709	7.74
						668	8.64
26	16.19	7.15	3.01	5.09	68.68	798	6.37
						782	6.62
						747	7.22
						744	7.25
						709	7.90
						670	8.74
12	16.24	9.27	3.02	1.23	70.36	778	6.40
						747	6.74
						709	7.46
						670	8.37
30			approximately			765	6.57
	16	9	3	3	69	730	7.17
						709	7.60
						670	8.43
31	15.94	8.95	3.06	5.06	67	765	6.68
						734	7.25
						709	7.76
						670	8.64
44			approximately			802	6.39
	15	5	3	1	76	784	6.63
						765	6.84
						728	7.48
						688	8.11
45			approximately			802	6.53
	15	5	3	3	74	765	7.00
						728	7.61
						688	8.24
46			approximately			802	6.65
	15	5	3	5	72	765	7.14
						728	7.70
						688	8.52
38	14.67	7.22	3.01	1.04	74.06	784	6.48
						765	6.78
						724	7.48
						709	7.75
						688	8.16
39			approximately			784	6.67
	15	7	3	3	72	765	6.95
						728	7.63
						709	8.02
40			approximately			802	6.64
	15	7	3	5	70	765	7.14
						728	7.83
						688	8.64
41	14.67	9.14	2.93	1.02	71.93	784	6.38
						760	6.71
						728	7.23
						700	7.81
						670	8.52
42			approximately			784	6.48
	15	9	3	3	70	765	6.76
						728	7.43
						688	8.27
43			approximately			784	6.59
	15	9	3	5	68	765	6.77
						728	7.62
						688	8.46
OSZ	16.43	6.17	3.58	0.36	72.37	771	6.35
						737	6.98
						702	7.63
						665	8.36
43-A	15.66	6.24	1.12	4.08	71.94	791	6.43
						771	6.68
						737	7.26
						702	7.88
						665	8.63
54	15.84	8.16	1.09	1.11	73.85	771	6.35
						737	7.02
						702	7.66
						665	8.41
71	15.60	10.18	3.15	4.28	68.02	771	6.55
						737	7.19
						702	7.94
						665	8.73
65	15.06	10.37	0.97	1.54	71.8	771	6.31
						737	6.94
						702	7.66
						665	8.41

Your order for Kaiser Alumina...

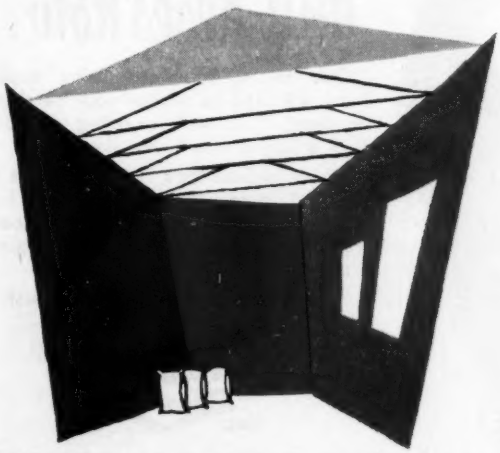


gets fast individual attention...

assuring immediate delivery...



often overnight, in emergencies...



thus reduces large, costly inventories.

This personal service—combined with unsurpassed quality and experienced technical assistance—has made Kaiser Chemicals a major supplier of calcined and hydrated aluminas. Today, we supply alumina to more than eighty per cent of the nation's users.

Whether you manufacture abrasives, glass, ceramics, refractories, catalysts, or chemicals for water treatment, we have the product and the service to meet your needs exactly. Contact principal sales offices: Chemical Division, Kaiser Aluminum & Chemical Sales, Inc., Oakland 12, California; First National Tower, Akron 8, Ohio.

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Alumina • Basic Refractory Bricks and Ramming Materials • Dolomite
Magnesia • Magnesite • Periclase

See our complete listing in Chemical Materials Catalog

SENSITIVE CORROSION MEASUREMENTS
(*Continued from page* 82)

the formation of a layer of insoluble salt having greater volume than the metal from which it was formed. Of the metals studied, only platinum showed no detectable dimensional change under the laboratory conditions. The three types of porcelain enamels studied varied widely in their chemical inertness as indicated by the test.

CURRENT STATISTICS . . .
(*Continued from page* 91)

hold glassware fell off 19 per cent during November 1953 to reach 3,015,412 dozens. This is a decrease from the 3,725,206 dozens sold during October. Sales during November 1952 were 3,665,760 dozens. At the end of the 12-month period ending November 1953, sales had reached a total of 40,617,652 dozens. This is only .4 per cent higher than the 40,430,863 dozens sold during the same period ending November 1952.

• Selas Corporation of America has formed a new subsidiary, Selas Constructors, Inc., Houston, Texas. R. T. Clare, Jr., will be its General Manager and Vice President.

• George P. Wertz has been named sales representative to serve Ohio, Michigan and part of Kentucky by the Alsynite Company of America. Mr. Wertz was formerly with Owens-Corning Fiberglas Corporation.

DIAMOND ALKALI APPOINTMENTS

David E. Pierce, nationally known chemical engineer, author and lecturer, has been appointed to the newly-created position of Director of Manufacturing Control at Diamond Alkali Company, according to an announcement by A. H. Ingley, Vice President-Manufacturing.

Having already assumed his new assignment, Mr. Pierce is directing his attention primarily to problems involving the appraisal and analysis of current manufacturing operations at Diamond's 14 plants throughout the country. He is responsible in this connection for coordinating these activities and formulating relative development programs leading to quality control advancement, efficiency improvement and cost reduction in the production of wide range of chemical products.

Also announced by the company is the appointment of John S. Cort, Jr. as Sales Manager of its Chromium Chemicals Division. Mr. Court succeeds Charles E. Grant, divisional sales manager since 1948, who has resigned to join Butler Manufacturing Company.

Mr. Cort assumes his new post at the company's Cleveland headquarters from Kearny, New Jersey, where he has been Assistant Manager of the Chromium Chemicals Plant for the past five years. Previously, he had been identified with the operations of the Diamond Silicate Plant at Cincinnati.

• Consolidated Chemical Industries, Inc. will move its New York offices from 630 Fifth Avenue to 380 Madison Avenue. The new telephone number is Oxford 7-1340.

and here's how . . .

Due to its superior fluxing qualities, Borax will tend to reduce your batch melting time . . . while enabling you to produce a bottle with fewer checks.

Write to Stauffer's Technical Sales Division for more information about F. M. Smith Brand Borax and the way it can increase your pack and reduce production costs.

Sulphurs — Nitrate of Potash

Stauffer CHEMICALS SINCE 1885

STAUFFER CHEMICAL COMPANY

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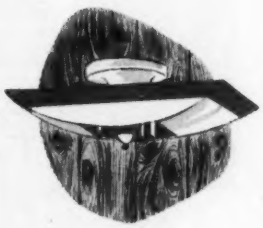
In today's competitive market, it's more important than ever to "show-off" your ware to best advantage. That's why so many leading manufacturers give their products the finishing touch of Colors by Vitro. From personal experience, they know Vitro Colors provide maximum eye appeal that means quick demand at the point of sale. Want more details on these quality colors—colors that are unsurpassed in purity, stability and uniformity? Write us today—there's no obligation.



Glass Colors by **Vitro**

VITRO MANUFACTURING COMPANY • 60 GREENWAY DRIVE, PITTSBURGH 4, PA.

Sales Offices In Principal Cities

BORATES IN GLASS INDUSTRY . . .
(*Continued from page* 77)

opinions. A review of all these opinions would be most time-consuming and beyond the scope of this paper.

Future Supply

The question of future supply can be answered with one word—adequate—for foreseeable needs at current demand rate for many years to come. These demands can be taken care of from the two major deposits of borax and sodium borate minerals at Searles Lake and in the Kramer District at Boron now being worked. Additionally, there are quite substantial reserves of ores containing Colemanite, a calcium borate mineral, in the Death Valley area in California.

The handling, shipping, conveying, storing and mixing and melting of borax and boric acid-containing batches have in the past posed some problems. The substitution of anhydrous borax and Anhydrous Rasorite for regular borax has practically eliminated caking, unless the anhydrous products are held in storage under humid conditions for long periods of time. Their substitution has entirely eliminated the puffing and subsequent dusting which used to give so much checker and stack trouble.

Within the past two years, serious efforts have been made to overcome the caking tendencies of boric acid and remarkable progress has been made. Bulk shipments of this product are now being received in a free flowing condition. Every effort possible is being made to maintain the fines content of these borates at as low levels as possible in order to reduce dusting during handling.

The borax industry has for a number of years offered its borax and boric acid with a guaranteed purity of 99½%. The anhydrous forms of borax are guaranteed to have a minimum purity of 99%. The two sodium borate ore concentrates, Rasorite and Anhydrous Rasorite, have been offered with a guaranteed minimum of 44% and 61.5% B_2O_3 equivalent to 63.5% and 88.9% anhydrous borax. However, the average anhydrous borax content of shipments of these two products are about 65% and 90%, respectively. The minor impurities in all products are described and quantities defined by a maximum value.

Customer specifications are usually written around or based on vendor's specifications. In any instance where the consumer or customer has a specific problem concerning the quality, composition, texture, or type of package in which material is shipped, the borax industry is anxious to review such problems and gladly do all within its ability to effect process or other changes in order to supply a customer with a more satisfactory product.

For example, during the past few years, we have reduced some of the minor impurities contained in some borates. We have also made anhydrous borax available in two additional mesh or screen sizes—this on suggestions from customers who felt such products would benefit their operations. Round-table discussions with customers' quality control groups serve as a most satisfactory ground for solving such problems.

I have attempted to give you in capsule form the relationship and importance of the borates to the glass industry. The reported effects of B_2O_3 on various glasses have either been published or reported directly to the writer in discussions with many industry friends.

Kahle
AUTOMATIC TRANSISTOR MACHINERY
you can produce from 30 per hour to 1200 per hour with KAHLE equipment

Now you can manufacture transistors that are evacuated and sealed in glass at rates from 30 to 1200 per hour or more! KAHLE, the largest producer of custom machines for the glass and electronics industries, supplies equipment for every operation in making a transistor or crystal diode,—manual, semi-automatic, fully automatic.
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"KAHLE—the built-in know-how"

AMCO
Design, Erection and Operation of Manufacturing Plants and Furnaces for All Types of GLASS WARE
AMSLER MORTON CORPORATION
CHAMBER OF COMMERCE BUILDING, PITTSBURGH 19, PA.

OWENS-CORNING AND M. I. T. JOIN IN ACOUSTICAL RESEARCH PROGAM

Owens-Corning Fiberglas Corporation is cooperating with the Massachusetts Institute of Technology in fostering general and acoustical research. The M. I. T. president's current report shows that Owens-Corning has become a member of the Institute's Industrial Liaison Program. The aim of this program is to keep industrial concerns in close contact with research developments and to support the research and educational activities of M. I. T.

A share of the grant made by Owens-Corning is allocated to the support of the Acoustics Laboratory for continued research in the vital field of acoustics. In connection with the grant, M. I. T. has announced the initiation of two Owens-Corning fellowships in acoustics to be awarded to outstanding graduate students whose interests lie in acoustics research. These fellowships will be awarded annually on a competitive basis.

W. C. TAYLOR NAMED CORNING GENERAL TECHNICAL ADVISOR

The appointment of William C. Taylor, Corning Glass Works Vice President, as General Technical Advisor for the firm headed a series of organization changes which have been announced.

Mr. Taylor, who has been a Vice President since 1943 and Director of Manufacturing and Engineering since 1948, will continue as Vice President and General Technical Advisor.

Dr. Charles F. DeVoe, Chief Process Engineer, has been appointed Director of Manufacturing Staffs, and Arthur W. Weber, Chief Mechanical Engineer, has been named Director of Engineering. John V. James, Manufacturing Division controller, has been appointed administrative assistant to Dr. DeVoe. Named Consultant to the Manufacturing Staffs was Chief Engineer Walter W. Oakley, and Justin J. Pfeiffer, Chief Planning Engineer, has been appointed Manager of Manufacturing Services.

CARBORUNDUM ACQUIRES STOCK OF STUPAKOFF

Agreement has been reached for The Carborundum Company to acquire the capital stock of the Stupakoff Ceramic and Manufacturing Company of Latrobe, Pa., according to an announcement by Major General Clinton F. Robinson, President of Carborundum.

General Robinson said the Stupakoff firm will continue operations under its present name and the present organization and personnel will be retained under the direction of Semon H. Stupakoff, President of the company. Stupakoff manufactures ceramic and other components used in the electrical and electronic industries, including metal-to-glass seals, Kovar metal for sealing to glass, etc.

• Eugene W. Dezmelyk recently joined the Research and Development Department of Foote Mineral Company as a Mechanical Engineer. He received his B.S. Degree in M.E. at the University of Pennsylvania and was employed by United Constructors and Engineers, Inc. and the Detroit Edison Company prior to joining the organization.

Speeds melting rate

Speeds fining rate

Improves durability . . . appearance

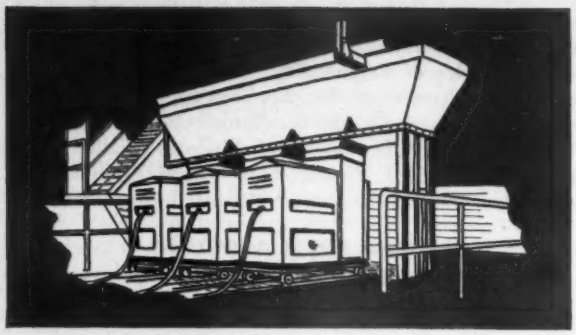
Container ware manufacturers are becoming increasingly aware of the merits of B_2O_3 as a minor constituent. A primary source of supply is the Pacific Coast Borax Co. with its continuous record of supplying highest quality boron compounds for more than fifty years. One single organization—from mine to refined product—assures top grade.

PACIFIC COAST BORAX CO.

DIVISION OF BORAX CONSOLIDATED, LIMITED

MANUFACTURERS OF FAMOUS 20 MULE TEAM PACKAGE PRODUCTS

NEW YORK • CHICAGO • CLEVELAND • LOS ANGELES



Uniform Chemical Ingredients
For Uniform High Quality Glass
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Every step in the processing of Gold Bond Glasshouse Lime is rigidly controlled from mine to end product to assure you of consistent high quality in every shipment. Lime variables are eliminated...a vital factor in the production of *good* glass. And National Gypsum Company *alone* offers the glass industry a complete line of *tested* lime products.

High Calcium Limestone
Dolomitic Limestone
Dolomitic Quicklime
Low-Iron Calcium Carbonate

Gold Bond
INDUSTRIAL PRODUCTS

NATIONAL GYPSUM COMPANY • BUFFALO 2, NEW YORK

Hovestadt's

"Jena Glass, and Its Scientific and Industrial Applications"

A Reprinting

• Hovestadt's "Jena Glass," translated into English by J. D. and A. Everett, published by Macmillan, 1902, has been out-of-print for years, and the original volumes are now collectors' items.

This book, setting forth the first really scientific study of glass and describing the pioneer efforts to correlate compositions and physical properties, ought to be in every technical library and in the hands of every glass technologist of today. Even though glass technology has progressed far in this half-century, it owes much to the painstaking work so completely and ably discussed in the book, of Winkelmann and Schott and their associates.

A lithoprinted edition of this book is now available.

Price, $4.00

THE GLASS INDUSTRY
55 West 42nd Street New York 36, N. Y.

"EXCELLENTLY MANAGED" GLASS COMPANIES

Six glass companies have been certified as "excellently managed" by the American Institute of Management of New York City: Anchor Hocking Glass Corporation, Corning Glass Works, Hazel-Atlas Glass Company, Libbey-Owens-Ford Glass Company, Owens-Illinois Glass Company and Pittsburgh Plate Glass Company.

According to Jackson Martindell, President of the Institute, only 348 companies in the United States and Canada, out of the 3,000 leading concerns whose methods were studied by the non-profit foundation, were found eligible to receive the designation for the year 1953.

STAUFFER APPOINTS DIRECTOR OF SALES

Theodore A. Haschke has been appointed Director of Sales of the newly-organized Industrial Chemical Division of Stauffer Chemical Company, its subsidiaries and associated companies, to take care of the increased scope of Stauffer's activities, it has been announced by Hans Stauffer, Executive Vice President.

Mr. Haschke started in the chemical business in 1919 and joined Stauffer seven years later. He was named Sales Manager of the Eastern Division in 1942, a post he held until this latest promotion.

FERRO APPOINTS FIBER GLASS REPRESENTATIVE

William G. Cole, Jr., Manager of the Fiber Glass Division of Ferro Corporation, has announced the appointment of The J. P. Schwebel Company as exclusive sales representative in the East Coast area for Ferro's "Uniformat" reinforcing products.

Offices of the Schwebel company are at 424 Madison Avenue, New York 17, New York.

PITTSBURGH SECTION FEATURES DUAL MEETING

The Pittsburgh Section of the American Ceramic Society featured two meetings in the Pittsburgh area on February 12, one held in Beaver Falls and the other in Greensburg.

R. F. Rea, Chairman of the glass meeting in Greensburg, planned a program featuring an informative and interesting discussion of stained glass by Wayne Housted, designer for The Blenko Glass Company. At the whitewares meeting in Beaver Falls, W. R. Kerr, Chairman, presented Philip Dressler who discussed the European whiteware industry and the influence of the economic conditions prevailing there.

OWENS-ILLINOIS ADDS TO PATENT STAFF

Wilbur A. Schaich, formerly a patent attorney on the staff of the Ford Motor Company, has been named Patent Counsel and Director of the Patent Department of Owens-Illinois Glass Company.

Before joining Ford, Mr. Schaich was patent counsel and head of the patent department of Dearborn Motors Corporation. He served in World War II as a patent officer in the Army Ordnance Department. At the time he entered the service, he was a member of the patent staff of General Electric Company in Washington.

CLASSIFIED ADVERTISEMENTS

WANTED

Need for production: Simpson Mixer, Raymond Mill, one or two Vibrating Screens. Please give full particulars. P. O. Box 1351, Church Street Station, New York 8, New York.

GLASS TANK FURNACES

Will pay reasonable price for a copy of Glass Tank Furnaces by Devillers and Vaerewyck, translated by Scholes. Reply Box 147, c/o The Glass Industry, 55 W. 42nd St., New York 36, N. Y.

FOR SALE

3 Continuous Annealing-Fusing Furnaces. 24" wide x 8" high x 43 ft. long, 36 KW, 220/2/60, 1450°F. comp. w/link chain, vari-drive-motor, trans. recorder—SP. $5200. Two 33" wide x 8" high x 48 ft. long, 55 KW, 220/3/60, 1450°F. comp. w/link chain, vari-drive-motor, trans. recorders, contactors switches, excellent condition, SP. $7800 each. Hanff Co., building heat treating furnaces and ovens since 1890, 216-224 Byron Place, Larchmont, N. Y. LA 2-3664. Also a variety of 200 other heat treating furnaces and ovens.

HELP WANTED

DECORATING DEPT. FOREMAN

Man with full knowledge of silk screening on glass. Semi-automatic equipment. Some mechanical ability required. Plant in Chicago. Room for advancement. Reply Box 144, c/o The Glass Industry, 55 W. 42nd St., New York 36, N. Y.

MACHINE OPERATORS wanted. Two 28 machine paste mold operators for work in Colombia, South America. Attractive living accommodations provided with adequate salary and other compensations including travel, lodging, food, etc. State qualifications, experience and salary expected. Reply Box 145, c/o The Glass Industry, 55 West 42nd St., New York 36, N. Y.

PENNSALT NAMES CHIEF CHEMIST

The Pennsylvania Salt Manufacturing Company has announced the appointment of Otto T. Aepli as Chief Chemist at their Wyandotte, Michigan, plant. Formerly Assistant Chief Chemist, Mr. Aepli replaces Earl Sweetland, recently retired.

After joining the company in 1944, Mr. Aepli worked as senior research chemist at the company's Whitemarsh Laboratories in Wyndmoor, Pa., until 1951 when he went to Wyandotte. He took his Bachelor of Science from the University of Pennsylvania and has a M.S. from Temple University.

H. I. THOMPSON ELECTS OFFICER

William C. Winterhalter has been appointed Executive Vice President and General Manager of H. I. Thompson Fiber Glass Company, according to an announcement by the Board of Directors.

Prior to his appointment by H. I. Thompson, Mr. Winterhalter was with Owens-Corning Fiberglas Corporation since its founding in 1938. When this company built its modern plant in Santa Clara, California, in 1949, he served as Vice President and Pacific Division Sales Manager.

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FOR THE GLASS INDUSTRY
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Automatic Glass Machinery
for the Manufacture of Incandescent Lamps and All Types of Electronic Tubes
BULB BLOWING MACHINES—AMPULE MACHINES
FORMS ALL TYPES AND SHAPES OF BULBS MADE FROM GLASS TUBING
VACUUM PUMPS
GLASS SLICING MACHINES
TORCHES—BURNERS
DIFFERENT TYPES AND SHAPES MADE ON EISLER'S AUTOMATIC AMPULE MAKING MACHINES
WE INVITE YOUR INQUIRIES
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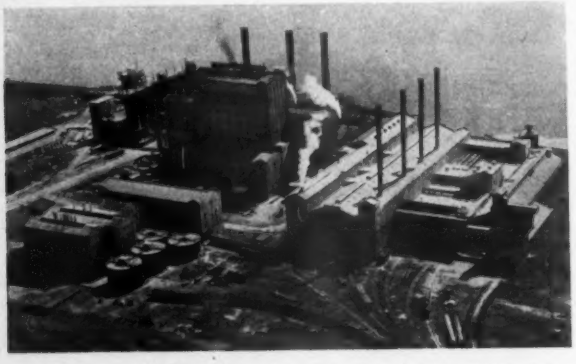
742 SOUTH 13TH STREET (near Avon Ave.) NEWARK 3, N. J., U.S.A.

Milestones in Glass Progress

PHOTO COURTESY TOLEDO MUSEUM OF ART

1761 This early English wine glass is inscribed, "Success to K George the III and the Queen 1761." After drinking the King's health it was the custom to break the glass—one of the reasons, no doubt, these glasses are so rare today. The toast was prophetic; George the III reigned for 59 more years, until his death in 1820.



1890 Michigan Alkali Company, now a division of Wyandotte Chemicals Corporation, was founded by Captain J. B. Ford to supply Soda Ash to the glass industry. Wyandotte has literally grown up with glass. Today, as in the past, it is a working partner, supplying raw-material chemicals to those great companies marking milestones in glass progress.

Wyandotte
REG. U. S. PAT. OFF.
CHEMICALS

Wyandotte Chemicals Corporation, Wyandotte, Michigan
Offices in Principal Cities

Founded by a Glassmaker to Serve the Glass Industry

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